A Comprehensive Revision of Tuberculosis Epidemiology and Control Program in Abu Dhabi

BY

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ABSTRACT

Introduction

Tuberculosis (TB) continues to be one of the challenging public health concerns, both globally and locally. According to the World Health Organization (WHO) Global TB Report 2016, there were an estimated 10.4 million new cases globally: 56% among men, 34% among women and 10% among children. In addition, people living with HIV accounted for 1.2 million (11%) of all new TB cases.

The distribution of TB cases varies widely across the globe with most cases focused on six countries, according to the report. The WHO produced the End TB Strategy in 2015 to control the disease and identified a set of targets to decrease the incidence of TB.

Two key factors for a successful program are understanding the epidemiology of TB and having a focused control program. This study will mainly focus on a detailed local analysis of the disease epidemiology and the revision of a TB control program.

Methods

This study was conducted using the existing database in the Department of Health, Abu Dhabi (DOH), UAE so as to understand the pattern of the disease over a 4-year period (2012-2015) and to identify change patterns, high-risk groups and major disease determinants. In addition, the same database was used to evaluate the benefits of GeneXpert in screening settings. Finally, a comprehensive review and evaluation of the program, using a WHO framework for evaluation of a TB control program, was used to understand the advantages of the program and offer recommendations for program improvement.

Results

This work investigates the Tuberculosis disease using local evidence and data in the hope of providing guidance to enable policymakers to set strategic directions for better control of Tuberculosis. Use of a standardized tool for the program's evaluation helps provide a clear and relatively objective picture.

The overall rate of TB in Abu Dhabi did showed no major change in the period between 2012-2015. The total number of TB cases increased over the years, but the burden rate did not change. The study highlighted risk factors related to TB and provided detailed baseline data. TB detection procedures improved from the period of the introduction of GeneXpert (MTB/RIF) in 2014. The evaluation of the TB control program provided feedback on the positive aspects of the program: TB detection and screening of high-risk groups. In addition, the study provided some suggestions for improvements such as treating child TB, providing treatment for latent TB cases and improving the detection of XDR by recommending the introduction of a central lab for referrals for drug sensitivity testing and second line TB medication.

Conclusions

The study provided a snapshot of the current program performance and highlighted the main strengths of the program such as screening, diagnosis and reporting. In addition the review of the program performance based on international framework, provided some suggestions on the way forward and the main areas of improvement.

Thesis advisory committee

- David Celentano, ScD
- Jonathan Golub, PhD
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- Laura Morlock, PhD
- David Dowdy, PhD, MD
- Public Health Practitioner: Mohamud Sheek Hussein, Dr.PH, DTM&H

Acknowledgements

This dissertation was a great experience for me to learn more and obtain my DrPH Degree. It was intended to provide the Regulatory Authority in Abu Dhabi Department of Health (DOH) with a useful and comprehensive tool that could be utilized by TB program managers at present and in the future. Much of this work was dependent on access to data sources available in DOH. I would like to thank all the members of the team working on the TB control program and visa screening for their support and contribution throughout the study. I would like to thank my mentor, Lilly Engineer for all the time and the guidance provided remotely. My special thanks to my advisors in John Hopkins for their continued support throughout the program.

Special thanks go also to my colleagues and mentors in UAE University, College of Medicine and Health Sciences for providing me with the local support needed to complete this study. This includes, but is not limited to, regular meetings and discussions about methodologies and analyses used in the research. I would like to thank my local practitioner, Dr. Mohamud Sheikh Husain for his guidance and support. I would also like to thank Dr. Iain Blair who was my initial local advisor in the DrPH planning stage.

I would like to thank all my colleagues and experts who participated in the evaluation of the Tuberculosis program for providing support in field evaluations and visits to facilities and for reviewing and updating checklist for Tuberculosis.

The evaluation was conducted as the first comprehensive review of the program since its establishment. I would like to list the names of the working group who participated in the evaluation and thank every member for their contribution. Special thanks to go Dr. Kamal Jaafar

and Dr. Ahmed Khudhair, the leader of the evaluation. I would like to thank Dr. Salwa Mustafa Kamal for her support and cooperation. Dr. Salwa led the evaluation of geneXpert in the laboratory in the pilot phase. Special thanks go to the Health Authority Abu Dhabi, named later as the Department of Health, for the support provided throughout my study.

I hope that I can present this study as a useful resource for TB programs that can be utilized in the future for the development of a TB control program.

Contents

CHAPTER 1

THESIS OVERVIEW

Tuberculosis is a global concern due to the large-scale global burden and the challenges associated with the disease. It is one of the top 10 causes of death worldwide. According to the World Health Organization (WHO) World TB Report 2017, around 10.4 million people fell ill with TB during 2016 and around 1.7 million died from the disease. Most TB deaths occur in low and middle-income groups where there are issues concerning access to TB treatment. Of the total cases reported in that year, 0.4 million cases of TB were of people with HIV and 1 million cases were of children. Around 64% of TB cases were concentrated in seven countries: India, Indonesia, China, Philippines, Pakistan, Nigeria, and South Africa.

One of WHO's targets is to end the global TB epidemic by supporting the End TB Strategy, which calls for a 90% reduction in TB deaths and an 80% reduction in the TB burden rate by 2030 compared with 2014. One of the main indicators for this strategy is the annual burden rate. According to the WHO Global Report for 2016, the estimated rate of TB in the UAE is under 24.9 per 100,000 population (1).

The first step towards reaching the elimination of TB is to have a good understanding of the disease status and baseline of the country. This understanding will help in monitoring both the effectiveness of the elimination strategy and the performance of the TB control program. This study is focused on understanding the epidemiology of TB, the updates on TB diagnostics and the performance of TB control program.

Manuscript One

Estimating the Burden of Tuberculosis in Abu Dhabi based on the notifications and screening of data including all age groups and nationalities for the years 2012 to 2015

This comprehensive review included two main sources of data: electronic notifications and visa screening. The objective of this study is to provide a clear understanding of the disease epidemiology of TB and to define any high risk groups to guide policymakers in improving the existing control program. In considering all cases reported from both systems, it covers the full study population including nationals and expatriates of varying age groups. It is consequently representative of the actual population. All applicants of the visa screening process are screened for TB and, if suspected of having TB, confirmatory testing is then mandatory. The study excluded recently arrived expatriates (new immigrants to Abu Dhabi within a one-month period of arrival from their home country) as they do not represent the local status and are more representative of their country of origin. The study included a review of the rate over time, the age adjusted rate and several major determinants of the disease such as age, gender, nationality, and occupation.

Manuscript Two

The evaluation of the benefits of using GeneXpert in the medical screening process for visa applications

The objective of this study is to evaluate the benefits of GeneXpert in a screening setting. The review considers data pre- and post- implementation of the test in the visa screening setting for confirmation of suspected TB. This is a retrospective study using visa screening data to measure the impact of change in the diagnostic modalities used in the program. Prior to the test introduction, all suspected cases had to provide sputum smear and culture. The data analysis included the calculation of the PPV, NPV, and time for confirmation. This study will provide some guidance for the use of geneXpert in screening setting.

Manuscript Three

Evaluation of TB control program in Abu Dhabi in alignment with the WHO Global Strategy using WHO Framework for conducting reviews of Tuberculosis programs.

This manuscript summarizes a comprehensive revision of TB control program components including field visits at different levels of the program including the central unit in Department of Health, Abu Dhabi, DOH, diagnosis facilities, screening facilities, primary health care settings and treatment facilities in both private and public sectors. This study aims to see the extent of alignment between the TB control Program in Abu Dhabi and the WHO Global Strategy so as to identify key opportunities for improvement based on UAE priorities. This qualitative measure of

the program is anticipated to provide guidance to local policymakers to inform revisions in policy and practice for program improvement.

CHAPTER 2

Estimating burden of tuberculosis in Abu Dhabi based on the notifications and screening data including all age groups and nationalities for years 2012 to 2015

Abstract

Background

A full review of TB epidemiology is required to provide a clear understanding of the disease determinants and risk factors and help program managers to plan for the disease control based on the local data.

Methods

The study is descriptive analysis utilizing existing data available in central Department of Health for the period from 2012-2015. Two data sources used for the study: Active screening and passive reporting. The analysis was done for each dataset separately and then combined the data to review main determinants and change over time. Combining both data allowed us to have a representation of the whole population with different nationalities and age groups. In addition, we calculated age adjusted rates of TB.

Results

Total cases of 3507 confirmed TB was identified in the period from 2012 untill 2015.

The year of 2012 had the highest rate of TB in notifications but no major change in the rate of TB over time of in visa screening system. The passive reporting of TB provided more information about TB among UAE nationals and children in addition to risk factors. Diabetes

and smoking were most prevalent risk factors among TB patients (approximately 8.4% of patients reported smoking and 7.6% reported history of Diabetes. Antimicrobial resistance rate MDR had a slight deline over time (ranged from .5 per 100,000 in 2012 to .38 per 100,000 in 2015). The change of TB prevalence rate was very minimal 2013 to 2015 (Age adjusted rate ranged between 23.1-25.5 per 100,000)

Conclusion

TB is most common among expatriates living in UAE especially those coming from countries with high burden of TB. The study provided more details about high risk groups by age, gender and nationality that can be used for program planning or policy guidance.

Introduction

In 2015, the United Nations adopted Sustainable Development Goals (SDGs) for 2030. One of the targets is to end the global TB epidemic by supporting the WHO End TB strategy which calls for a 90% reduction in TB deaths and an 80% reduction in the TB burden rate by 2030 compared with 2014. One of the main indicators for this strategy is the annual burden rate. According to the WHO Global Report, 2016, the estimated rate of TB in the UAE is below 24.9 per 100,000 population (1). The first step towards reaching elimination is to know the disease status and baseline of the country. This will help in monitoring the effectiveness of the elimination strategy and the performance of TB control program itself.

Abu Dhabi is the capital of the UAE with a population of around 3 million, approximately one third of the total UAE population and around 87% of the total area. This population composition includes a unique mix of people coming from both TB endemic areas and countries of with very low prevalence of TB. This mix of people imposes a burden on the UAE health care system in its attempts to maintain a relatively low level of TB in the country.

The Health care system in Abu Dhabi is well established. TB is one of the priority diseases included in the National and Local level plans. The most recent national annual health report for the UAE was published in 2010 and included statistics and data about TB in the country. In 2016, the burden rate of TB in the UAE was 1.6 per 100,000 population (range between 1.1-2.1). The mortality rate due to TB and HIV was around .32 per 100,000 population. The percentage of TB cases with MDR-TB was 1.7% per 100,000 population (1).

A search of local publications about the epidemiology of TB revealed two studies.

The first study was a retrospective epidemiological analysis performed in Al Ain (Eastern Abu Dhabi region) (1). The period of analysis was from 1995-2000. The mean burden rate reported during this period was 7.1 per 100,000 population: more than three times that reported for the period 1983-1992. The study also conducted a genetic analysis for seven isolates and found a unique strain in the UAE that did not match >4000 different individual strains (6).

The second study was conducted in the UAE Emirate of Sharjah to investigate the pattern of TB distribution among the northern emirates population for the period 2004-2008. The study reviewed around 1,810 samples of suspected TB and found 312 culture-positive TB cases. Most cases were seen among South and South East Asian nationalities (36%). Only 16% of cases were seen among UAE nationals and more than two-thirds of these cases were males (7).

A regional study done in the Kingdom of Saudi Arabia (KSA) to investigate the trends of TB in the kingdom during the period 2005 - 2009 concluded that the rate of TB in non-Saudis was twofold higher compared to Saudis (8).

A further example of the impact of immigrants on TB epidemiology is from Sweden. The burden of TB is around 5.5 per 100,000. Approximately 10% of the population of Sweden are immigrants from 42 different countries. The study considered TB strains during the period 2001-2005 and found 349 patients, 17% of whom came from European countries. Around 28% were of various African nationalities and 16% came from Asian countries. The study concluded that immigration from high burden countries had a greater impact on TB epidemiology than that from

the low burden countries and that this should be taken into consideration when planning TB control strategies (9).

The UAE entered a new era of public health electronic surveillance with the establishment of the Department of Health Abu Dhabi (DOH) in 2005 as the regulator of the health care system in the Emirate of Abu Dhabi and the new establishment of public health within DOH. The current system allows the UAE to gather information from various sources to give an indication of the burden and prevalence of TB in Abu Dhabi among both national and expatriate populations. One of the strengths of the surveillance system for infectious diseases is the ability to access live data with automated analysis that provides a live-time report of the current status. This database is also a rich source of information for epidemiological studies aiding more understanding of the disease, its risk factors and its distribution.

A careful review of information gathered from the electronic notification system, the main source of passive reporting of suspected and confirmed cases in public and private hospitals, helped estimate the burden of TB in Abu Dhabi. In addition, the active annual screening of all expatriates (newcomers and renewals) was used as another important source of data.

To achieve a reduction in the rate of Tuberculosis in Abu Dhabi and the UAE in general, the epidemiology of the disease must be studied. Trends must also be understood as well as determinants and risk factors associated with the disease. This study is conducted to provide policymakers with a comprehensive overview of the burden of TB in Abu Dhabi utilizing existing sources of information.

METHODS

Data sources

The study utilized two existing databases for TB in Abu Dhabi: Infectious Diseases Notification and the Visa Screening System. Detailed case information was also available and included patient demographics, clinical information, and lab results. The study covered all records available from January, 2012 until December, 2015. Notifications processed in the electronic system are reviewed and verified by the TB team. Should any case fail to fulfil the definition criteria of TB, it is excluded from the system. The population data obtained from the DOH database includes age, gender, nationality for the period 2012-2015.

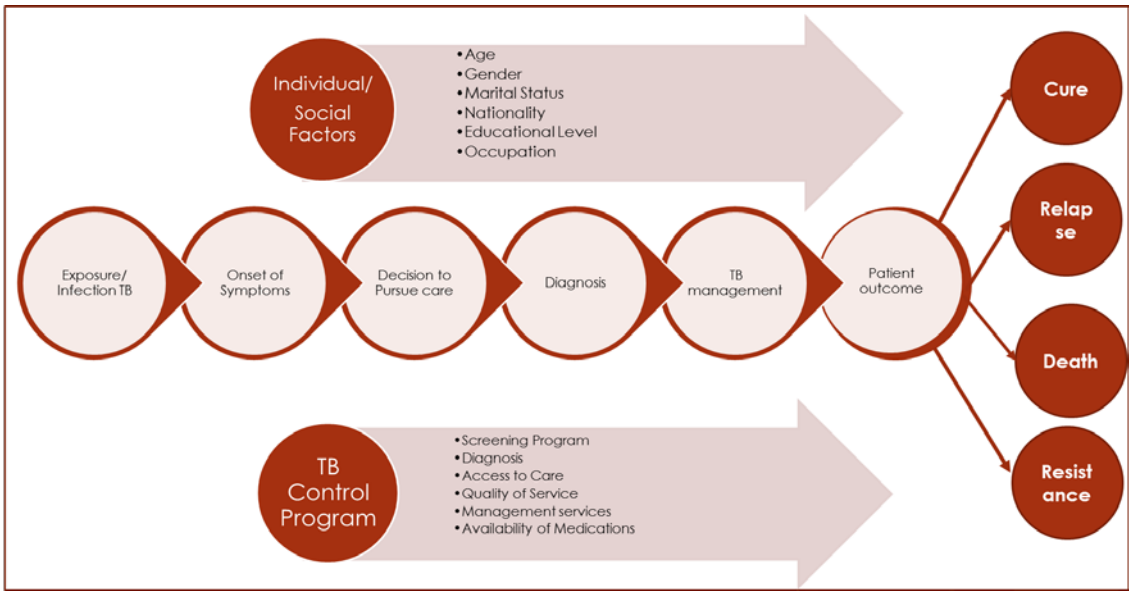
The case definitions used in this study are the WHO standard case definitions (10):
"a bacteriologically confirmed TB case is one from whom a biological specimen is positive by smear microscopy, culture or WRD (such as Xpert MTB/RIF). A clinically diagnosed TB case is one who does not fulfil the criteria for bacteriological confirmation but diagnosed with active TB by a clinician or other medical practitioner who has decided to give the patient a full course of TB treatment. This definition includes cases diagnosed based on X-ray abnormalities or suggestive histology and extra-pulmonary cases without laboratory confirmation.

Pulmonary tuberculosis (PTB) refers to any bacteriologically confirmed or clinically diagnosed case of TB involving the lung parenchyma or the tracheobronchial tree. Military TB is classified as PTB because there are lesions in the lungs. Tuberculous intra-thoracic lymphadenopathy (mediastinal and/or hilar) or tuberculous pleural effusion, without radiographic abnormalities in the lungs, constitutes a case of extra-pulmonary TB. A patient with both pulmonary and extra-pulmonary TB classified as a case of PTB.

Extra-pulmonary tuberculosis (EPTB) refers to any bacteriologically confirmed or clinically diagnosed case of TB involving organs other than the lungs, e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joints and bones, meninges.

Multidrug-resistant tuberculosis (MDR-TB) is a form of TB caused by bacteria that do not respond to isoniazid and rifampicin, the 2 most powerful, first-line anti-TB drugs. Extensively drug-resistant tuberculosis (XDR-TB) is a form of TB, which is resistant to at least four of the core anti-TB drugs. XDR-TB involves resistance to the two most powerful anti-TB drugs, isoniazid and rifampicin, in addition to resistance to any of the fluoroquinolones (such as levofloxacin or moxifloxacin) and to at least one of the three injectable second-line drugs (amikacin, capreomycin or kanamycin)".

Figure1: Conceptual Framework



List of Variables Used

The initial analysis was done for each dataset separately and included a list of variables shown in Appendices 1 and 2. Matching of the common variables was done to match both datasets. The nationality group was created to merge groups of countries based on WHO region distributions.

Data Analysis

Data analysis was conducted using STATA and SPSS software. Notifications data were revised for completeness and data quality.

Exclusion Criteria

The exclusion for the cases that included the field (Discard reason) was done based on case definition. Cases reviewed in the central unit of DOH and confirmed as TB were excluded. Reasons for discarding were stated in the database. The principal reasons for exclusion were changing the diagnosis to other conditions or duplication (as records was separately available in the visa screening dataset). This additional point of check provided a higher quality of data.
In the visa screening database, incomplete suspected cases were excluded to ensure the quality of case definition.

Analysis by Nationality

Due to the long list of nationalities observed in the database, the grouping of countries was done based on WHO regions. This was important to simplify the analysis and to ameliorate

comparison to published WHO data. Simple frequency count of positive cases was done after grouping. The grouping of countries was:

1. Africa
2. Americas
3. South-East Asia
4. Europe
5. Eastern Mediterranean
6. Western Pacific

Visa Screening Data

Analysis of Visa screening results consisted of trend over time, frequency, and tabulations. A comparison between new rates and renewals rates of TB was carried out. In addition, a calculation of mean and median values for different variables was included. A review of Visa Screening applicants based on residency status (newcomers versus renewals) was important as previous research had confirmed a major difference in TB rates between both types.

E-Notification Data

The analysis of pulmonary TB notifications and Extra-pulmonary notifications was conducted for each dataset separately. It included a review of data quality, the completeness of fields and the selection of appropriate fields in the analysis. Frequencies, the distribution of age groups and nationalities were then calculated. It is important to highlight that the method of passive reporting from hospitals included additional clinical details to that of the visa screening data,

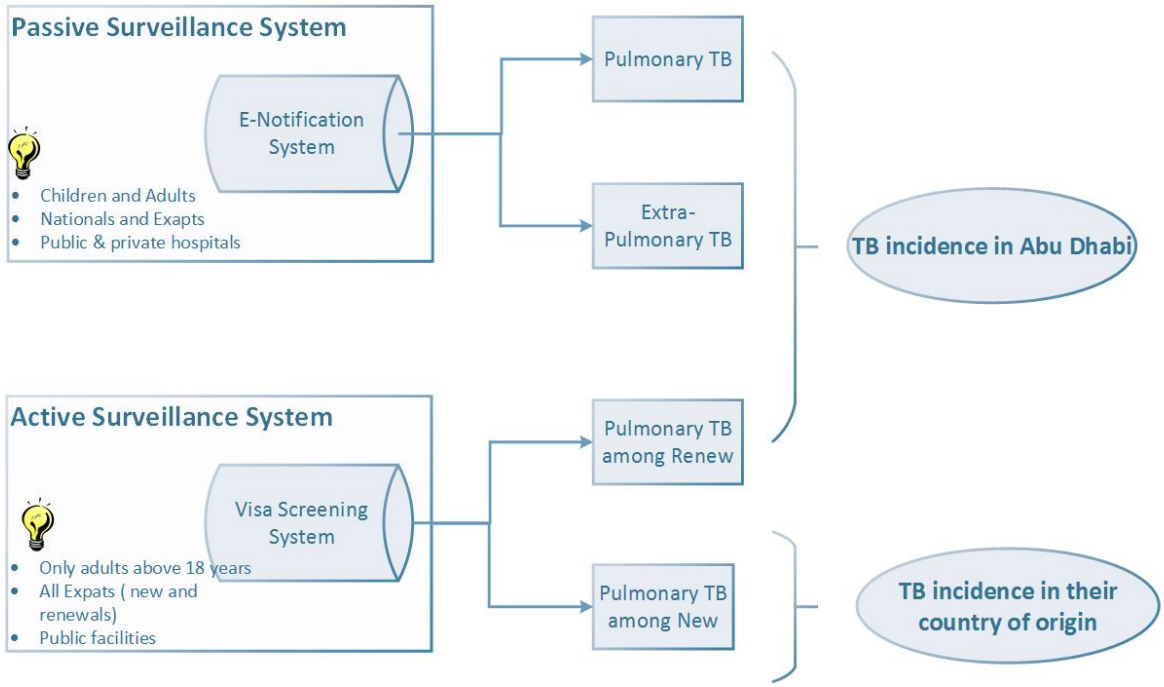
such as risk factors, drug resistance and previous history of the disease. Although not all fields were fully completed, most cases consisted of a sufficient list of required variables.

Combined Data

To estimate the burden of TB in Abu Dhabi, it was necessary to exclude newcomers as it was considered that they reflected the TB rates in their country of origin rather than in the Abu Dhabi population. The method of calculation is shown in Figure 2. The basic variables of age, gender, nationality and diagnosis provided one set of data for analysis of all age groups and nationalities represented in the Abu Dhabi population. Further analysis was carried out to identify the total population and calculate both crude rates and age adjusted rates. An age standardized calculation was done based on WHO standards (14). In addition, a calculation of mean age over time was carried out to examine the change in the population infected with TB.

Figure 2: Summary of data selection process to estimate TB Burden in Abu Dhabi

Figure2: The process of data selection from all available sources to calculate TB Burden in Abu Dhabi



RESULTS

Section A

Active Screening of Expatriates

During the period from January, 2012 to December, 2015, 2,235 confirmed cases of TB were identified through the Visa Screening System. Most cases diagnosed were among newcomers (69.8% of the total TB cases). Table 1 shows the main difference between new and renewal groups according to age, gender, nationality group and occupation.

The mean age for newcomers diagnosed with TB was around 40 years, which is very similar to the renewal group. In addition, most of the affected cases were males (82.7% from newcomers and 86.5% from renewals).

In considering the nationality group, most of the affected cases emanated from South East Asia, followed by the Middle East. The least affected group was America.

Table 1. Summary of Visa Screening positive TB by residency status 2012-2015 (n=2235)

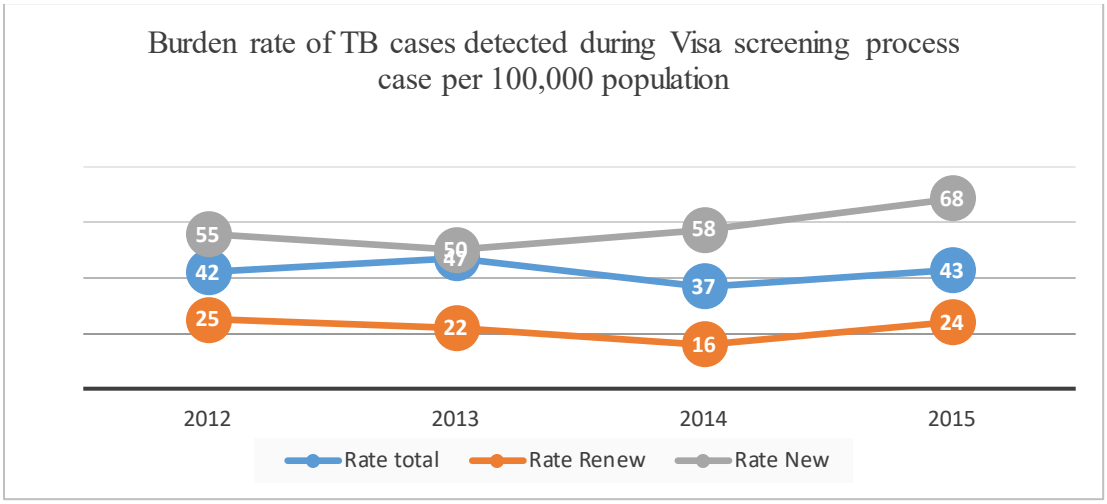
	New		Renew		Total
	N	%	N	%	
Age years Mean)	40		39.1		
Gender					
Female	267	17.3%	94	13.5%	361
Male	1275	82.7%	603	86.5%	1878
Nationality Group*					
Middle East	544	35.3%	180	25.8%	724
South East Asia	730	47.3%	400	57.4%	1130
Africa	64	4.2%	24	3.4%	88
Europe	8	0.5%	2	0.3%	10
Western pacifica	195	12.6%	91	13.1%	286
America	1	0.1%	0	0.0%	1
Occupation group**					

A	1216	78.9%	588	84.4%	1804
Bi	215	13.9%	78	11.2%	293
Bii	111	7.2%	31	4.4%	142
Year					
2012	327	21.2%	126	18.1%	453
2013	289	18.7%	212	30.4%	501
2014	407	26.4%	112	16.1%	519
2015	519	33.7%	247	35.4%	766

TB Annual Incidence Rate

The annual burden rate appeared to show differences between both groups. The annual burden rate of TB among newcomers ranged between 55-68 per 100,000 population, relatively higher than the rate of TB among renewals, which ranged between 24-43 per 100,000 population. The overall rate of TB between both groups showed no major change over the period of study (4 years). It is very hard to estimate how much of renewal population is new case or, latent reactivation due to absence of this information in the system. Renewal population screened regularly in their renewal and active cases are filtered and treated.

Figure 3: Burden rate of TB in Visa screening system TB by residency status 2012-2015 (n=2235)



Confirmation Methods

Most cases were confirmed either by Culture or the GeneXpert test used from 2014 onwards. Prior to this period, all suspected cases of TB had positive culture results. In the year 2015, around 55% of the total positive cases were confirmed using GeneXpert.

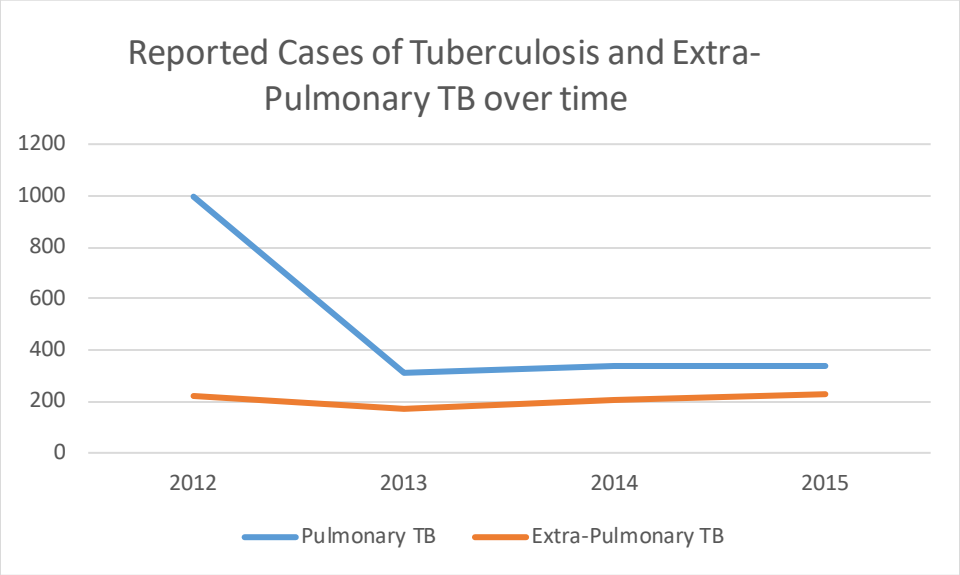
Section B

Passive Reporting of TB

During the period from January, 2012 to December, 2015, 2,810 TB cases were confirmed in Abu Dhabi from both private and public hospitals. This total included 1,982 notifications of pulmonary TB and 828 extra-pulmonary TB. Figure 4 shows the number of notifications by type of TB disease each year. Year 2012 showed a majority of the reported cases and the least number

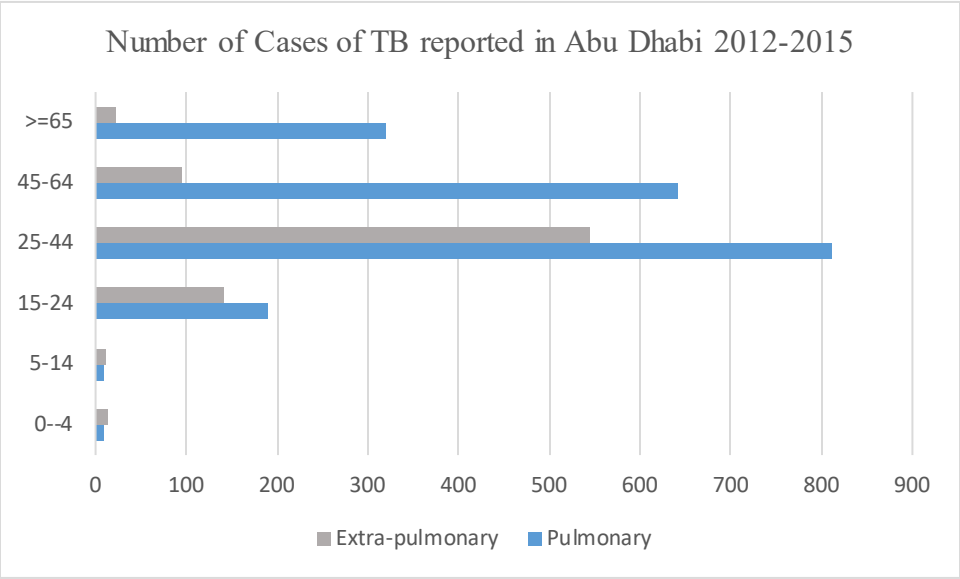
of discarded cases (only one case). This result might indicate some data quality issues. The number of cases reported with pulmonary TB was higher than that reported with extra-pulmonary TB.

Figure 4: Number of TB cases reported by the E-Notification system during 2012-2015 (n=2810)



The reported cases included varying age groups and included children under 4 years of age. The data are an important source of information concerning children. Figure 4 shows a summary of TB cases by age group. Extra-pulmonary TB is more common in children under 15 years of age than TB. In addition, most of the affected cases were predominantly among young adults (25-44 years).

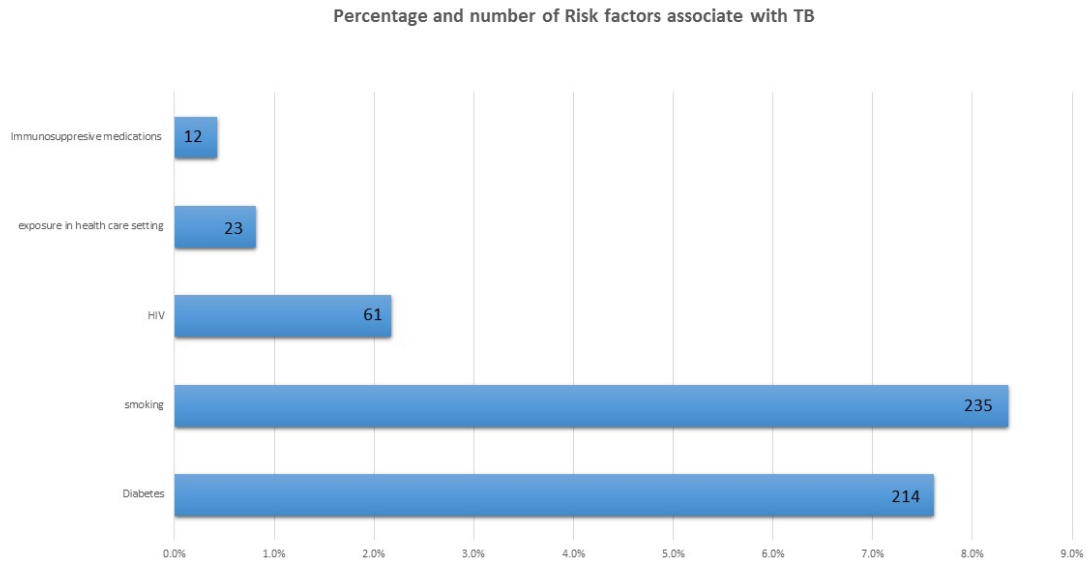
Figure 5: Number of TB cases reported by the E-Notification system during 2012-2015 by age groups (n=2810)



Risk Factors Associated with TB

Risk factors associated with the disease are shown in Figure 6. Approximately 8.4% of patients reported with TB (including both pulmonary and extra-pulmonary) were smokers. In addition, around 7.6% of patients had a history of diabetes. HIV is one of the known risk factors of TB and around 2.2% of the total number of cases reported had a history of HIV prior to the onset of the disease.

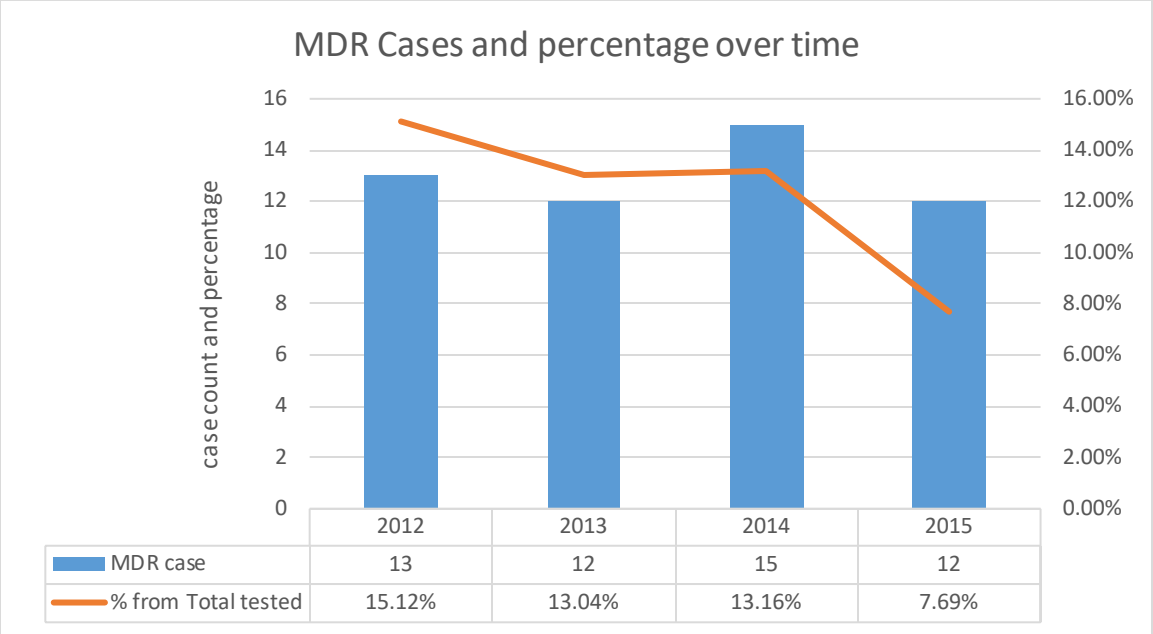
Figure 6: Number of TB cases reported by the E-Notification system during 2012-2015 by risk factors (n=2810)



Antimicrobial Resistance

The database included results of antimicrobial resistance. Figure 7 shows the details of drug resistance over time. It is clear from the Figure that 2014 shows a majority of MDR cases (15 cases in the same year). The number of cases tested increased over time and the percentage of cases with MDR decreased over time.

Figure 7: Drug resistance pattern over years based on Pulmonary & Extra-Pulmonary notifications (2012-2015)



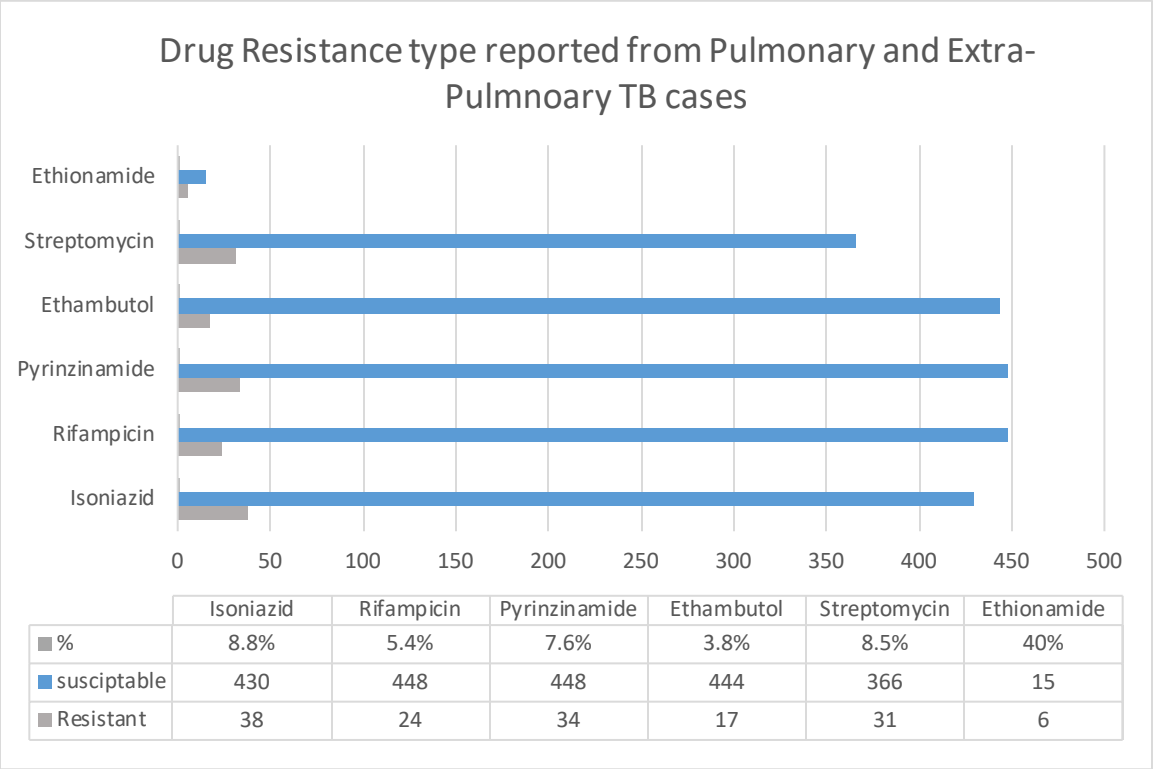
In addition, the rate of TB MDR shows a slight decline over time starting with 0.5 per 100,000 population in 2012. The rate by 2015 was 0.38 per 100,000 population.

Table 2 Summary of MDR and XDR status from notified cases 2012-2015

Year	MDR case from pulmonary cases	MDR case from extra-pulmonary cases	Total cases	Total Tested	MDR rate/100,000
2012	10	3	13	86	0.50
2013	12	0	12	92	0.44
2014	15	0	15	114	0.54

2015	11	1	12	156	0.38
Total cases	48	4	52	448	

Figure 8: Drug resistance Type reported from Pulmonary and Extra-Pulmonary TB case (2012-2015)



	Isoniazid	Rifampicin	Pyrinzinamide	Ethambutol	Streptomycin	Ethionamide
%	8.8%	5.4%	7.6%	3.8%	8.5%	40%
susciptable	430	448	448	444	366	15
Resistant	38	24	34	17	31	6

Figure 8 shows the most common types of medication tested for susceptibility. Isoniazid is the most common type of drug with a resistance level of 8.8%. Resistance to second line medication is also reported: approximately 8.5% of cases tested were found to have resistance. There is insufficient data to comment on XDR: data were available from only two medications of second line treatment and remaining data were missing.

Around 8% of the cases reported had a previous history of TB diagnosis, which possibly indicates a relapse or previous incomplete treatment. Moreover, around 6.3% of cases reported previous treatment for TB.

Table 3 History of Previous TB diagnosis and TB treatment

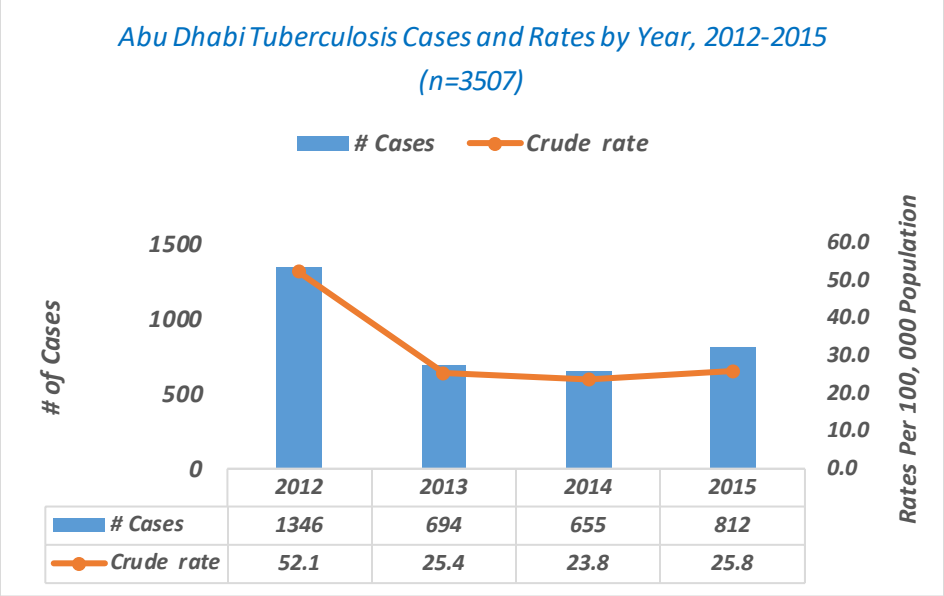
History of TB	2012	2013	2014	2015	Total Number	Total percentage
TB previous diagnosis	11	60	83	72	226	8.0%
TB previous Treatment	6	51	68	52	177	6.3%

Section C

Combined Data and Calculation of TB Burden

The Emirate of Abu Dhabi reported 3,350 new tuberculosis cases during the period 2012 to 2015. Analysis of the figures indicated a 52% decrease from 1,352 TB cases reported in 2012 to 654 cases reported in 2015 (see Figure 1). Similarly, the TB crude incident rate showed a decrease from 52.4 cases per 100,000 population in 2012 to 25.8 cases per 100,000 in 2015.

Figure9: Tuberculosis cases and rates by year 2012-2015



TB in Abu Dhabi occurred predominantly among males (2,597 cases, 77.5%), compared to females (753 cases, 22.5%). TB occurred in all age groups, but the most affected age groups were 25-44 year olds (1,707 cases, 51.0%) and 45-64 year olds (877 cases, 26.2%). Children, teenagers or young adults were the least affected age group of TB cases (see Table 1). Nationalities in Abu Dhabi were disproportionately affected by TB. Expatriates accounted for 94.2% of TB cases compared to UAE nationals (5.8%).

Table 4. Tuberculosis Cases and Percentage by Gender, Nationality, and Age Group (2012-2015 (n=3507)

Demographic	***Frequency***	***%***
Total	*3507*	*100.0%*
Gender		

Male	*2738*	*78.1%*
Female	*769*	*21.9%*
Age Group		
0-4	*23*	*0.7%*
5-14	*20*	*0.6%*
15-24	*392*	*11.2%*
25-44	*1812*	*51.7%*
45-64	*913*	*26.0%*
>=65	*347*	*9.9%*
Nationality		
UAE National	*3312*	*94.4%*
Expatriate	*195*	*5.6%*

From 2012–2015, the age-adjusted rates of TB cases declined by 84.5%: from 130.6 per 100,000 in 2012 to 25.5 per 100,000 population in 2015. Among the 3,507 TB cases in Abu Dhabi, Routine Surveillance reported a higher number of TB cases (1,982) compared to Visa Screening (697). The routine surveillance TB cases (1,982, 56.5%) were all pulmonary tuberculosis cases. In 2015, the burden rate for males versus females was 26.8 per 100,000 population (male) to 20.7 per 100,000 population (female). Comparing UAE nationals with expatriates, a higher percentage of expatriate cases were diagnosed with TB.

Table 5: Summary of total cases reported from notifications and visa screening (n=3507)

	TB positive Notifications		**Extra-pulmonary Notifications**		**TB positive Visa Screening Renewal**		**Age Adjusted Prevalence Rate of TB (per 100,000)**	**95% confidence interval**	
	N	%	N	%	N	%		Lower limit	Upper limit
Age years Mean)	40.0		32.9		39.1				
Gender**									
Female	448	22.6	227	27.4	78	14.8%	20.7	17.6	23.8
Male	1534	77.4	601	72.6	462	85.2%	26.8	24.8	28.9
Nationality Group*									
EMRO	692	39.1%	282	37.2	258	37.5%	N/A	N/A	N/A
SEARO	961	54.3%	440	58.7	396	58.8%	N/A	N/A	N/A
AFRO	117	6.6%	30	4.0	20	3.7%	N/A	N/A	N/A
Nationality status**									
UAE (National)	132	6.7	63	7.6	0	0	7.9	5.0	10.7
Expatriates	1850	93.3	765	92.4	540	100	29.9	27.8	32.0
Year									
2012	996	50.3	224	27.1	126	18.1%	130.6	123.6	137.5
2013	311	15.7	171	20.7	212	30.4%	26.8	24.8	28.8

2014	338	17.1	205	24.8	112	16.1%	23.1	21.4	24.9
2015	337	17.0	228	27.5	247	35.4%	25.5	23.8	27.3

** Only top 3 WHO region countries cases and percentages*

*** Rate equals only 2015 cases*

N/A = Total denominator data not available

Table 6. Tuberculosis Cases Mean Average Age by Gender and Year (n=3507)

Gender	2012	2013	2014	2015
Female	53	35	36	38
Male	54	37	37	36

In addition, the mean average age of cases affected with TB ranged between 35-38 during the 2013-2015 with only a minor variance between males and females. The mean average age in 2012 was 53 among females and 54 among males.

DISCUSSION

This study provided a comprehensive overview of TB in Abu Dhabi using all available data from various programs to gain a better understanding of TB status and the change thereof over time.

It is clear from the study that the prevalence rate of TB among the local population compared to expatriates is low, the age adjusted rate for UAE nationals being 7.9 per 100,000 compared to 29.9 per 100,000 for UAE expatriates.

Screening for TB among high risk groups is one of the important tools for a TB control program. The estimate is consistent with the WHO global report, 2016 which considered the burden rate of TB in United Arab Emirates as low (burden between 0-24 per 100,000) (1).

The focus on immigrant population in terms of screening for TB and early detection is known practice in countries with a low TB burden, especially for immigrants coming from countries with a high incidence rate of TB. A study conducted in Spain confirmed that TB is the most common infection detected among immigrants coming from Sub-Saharan Africa and North America (14). Among the expatriate population, it is clear most cases are detected in newcomers compared to the resident population. This might reflect a higher incidence of TB in the country of origin, but outbreaks can be prevented by strengthening home screening.

The study describes a higher rate of TB in males compared to females. The male to female ratio is around 3.5:1. In addition, it is clear from the age group distribution that TB is more common in the young population between 25-44 years of age, which is not in line with the WHO Global Report 2016. Only few countries in Africa, specifically Nigeria and Zambia, had higher rates of TB among young adults whereas most of Asian countries had higher rates of TB among the elderly population. This might reflect the population proportion since the majority of the working force are young and coming from countries with high rates of TB. It might also reflect the fact that higher transmission rates are found in the young adult population and lower rates of transmission are found in the elderly population. It is clear from the results that young adults and children are more likely to present with extra-pulmonary TB compared to older adults.

The active screening of expatriates provides a high yield of detection compared to notification, which is useful for early detection and management. Screening is worth doing: significant benefits include the early identification of risk groups, possible timely

treatment/chemoprophylaxis intervention, and the prevention of transmission by significantly reducing infectiousness with subsequent avoidance of hospitalization (44).

The study of TB rates over time showed no major change during the period of study 2012-2015. The number of notifications for pulmonary TB in 2012 was very high for unexplained reasons and the rate of TB with multi-drug resistance in the same year was higher compared to subsequent years. However, from the screening data, there was no similar finding. The range was between 37 to 42 per 100,000. The TB crude rate decreased from 52.4 cases per 100,000 population in 2012 to 25.8 cases per 100,000 population in 2015. This might be due to the higher rates of pulmonary TB notifications in year 2012. A study of tuberculosis burden for the Al Ain Medical District showed a burden of tuberculosis in the UAE which increased from 18.9 cases per 100 000 population in 1989 to 28 cases per 100 000 population in 1998 (9).

The study also confirms common risk factors associated with the disease: smoking, diabetes and HIV. Smoking ranked top of all risk factors commonly found among cases of TB.

The data about TB MDR show a slight decline over time starting with 0.5 per 100,000 population in 2012. By 2015, it was 0.38 per 100,000 population: much less than the previous rates published in other studies. In reviewing similar local studies, there was study in Al Ain which described evidence of 'emerging' multidrug-resistant M. tuberculosis strains in the Al Ain Medical District, UAE. Incidence increased from 1.4% in 1997-1998 to 8.5% in 1999-2000(9). Another Study of TB in Sharjah, UAE reported rates of TB MDR to be around 3.8% (10). Recent datasets examined show a decline in the resistance rate for the period 2012-2015 where in 2012 there was around 14% of positive samples showing MDR. By the end of 2015, only 8% of the

total tested showed TB MDR. The study of XDR was limited in this study because of the small number of cases tested for second line medication sensitivity.

Limitations of the study included missing TB treatment coverage data that could have provided additional information about the program performance and outcome of cases. The study excluded patient geographic location to highlight specific locations of high risk. The study of patient outcome was a very important element of TB management effectiveness. The methodology of the study included the elimination of duplicated files between the two datasets, but did not take into consideration the reporting of the same case in subsequent years which might give an indication about treatment failure.

CONCLUSION

In summary, this is the first comprehensive review of local TB data to estimate the burden of TB in Abu Dhabi. There are very limited studies which have been done in the United Arab Emirates and in the Gulf Region to study the disease determinants and the trend of the disease over time. The main objective of this study was to provide a holistic view of the disease in the Emirate of Abu Dhabi using existing datasets to provide the local authority with a better understanding of high-risk groups, risk factors and the trend of the disease over time.

The results of the study showed a slight decline in the rate of TB over the period of 4 years from 2012-2015. The most affected groups were newcomers arriving to work and reside in Abu Dhabi. Among the resident population, the young adult male working population from areas of high rates of TB seemed to have the highest rate of TB. The drug resistance pattern was in slight

decline over time. Smoking was the top risk factor of the disease. TB/HIV cases were limited in the population studies.

We recommend further study of MDR/XDR rates and a more systematic testing for cases diagnosed with TB. In addition, further studies of the TB DOT program performance might be useful to guide policymakers on the effectiveness of TB control strategies.

APPENDIX 1 – List of variables used in Visa screening system

Variable Name	Label & Units	Format	Codes
Year	Year of test	**yyyy**	
APP_NO	Number of specific code for each applicant of visa screening. It is a unique number for each encounter with visa screening	Text & Numbers	None
APPLICANT NATIONALITY	Nationality of visa screening applicants. Each country is mentioned	Nationality list	None
Nationality2	Nationality according to WHO regions	AFRO EMRO South East Asia Western Pacific American Europe	1-6
Date of birth	Date of birth of applicants	Date: dd/mm/yyyy	None
Age	Age in years	number	=INT(YEARFRAC(E3; K3))
VISA TYPE	New or renew in the country	text	New or Renew

GENDER	Male or Female	text	Male or female
APPLICANT OCCUPATION	Occupation of the applicant	text	List of occupations
APPLICANT CATEGORY	Occupation groups based on Visa screening requirements	text	A Bi Bii
START DATE	Date of testing	date	Dd/mm/yyyy
RAD_OBSERVATION_1	The CXR reading by the first radiologist	Text/number	PH030 Normal PH031 Abnormal not PTB PH032 Old PTB PH033 High suspicion active PTB PH034 Medium suspicion active PTB PH035 low suspicion active PTB
RAD_OBSERVATION_2	The CXR reading by the second radiologist	Text/number	PH030 Normal PH031 Abnormal not PTB

			PH032 Old PTB PH033 High suspicion active PTB PH034 Medium suspicion active PTB PH035 low suspicion active PTB
RAD_OBSERVATION_3	The CXR reading by the third radiologist	Text/number	PH030 Normal PH031 Abnormal not PTB PH032 Old PTB PH033 High suspicion active PTB PH034 Medium suspicion active PTB PH035 low suspicion active PTB
AFB SMEAR 1st	AFB smear results first sample	Text/number	PH040 0 per 300 fields PH041 1 per 300 fields PH042 2 per 300 fields PH043 +1

			PH044 +2 PH045 +3
AFB SMEAR 2nd	AFB smear results second sample	Text/number	PH040 0 per 300 fields PH041 1 per 300 fields PH042 2 per 300 fields PH043 +1 PH044 +2 PH045 +3
AFB SMEAR 3rd	AFB smear results third sample	Text/number	PH040 0 per 300 fields PH041 1 per 300 fields PH042 2 per 300 fields PH043 +1 PH044 +2 PH045 +3
TB CULTURE 1st	Culture results 1st sample	Text/number	PH047 No growth PH048 MTB PH049 MOTT PH050 contaminated
TB CULTURE 2nd	Culture results 2nd sample	Text/number	PH224 No growth

			PH228 MTB
TB CULTURE 3rd	Culture results 3rd sample	Text/number	PH238 No growth PH239 MTB
TB PCR	TB PCR results gene expert test		450 Negative 451 Positive 453 Indeterminate
RIF	Rifampicin resistance		
TST	Tuberculin skin test	number	From 1 to 10 Note some used number then mm
IGRA	IGRA results	Text/number	PH197 PH198 PH199
ACTION ID	Results of the certificate fit or unfit	number	-1 incomplete results 4 Active TB unfit 5 Old PTB unfit 9 pending results 11 previously unfit case

NEW ACTION ID	Revised results by the team action is changed	number	1 fit 2 fit and follow up 3 4 Active PTB unfit 5 old ptb unfit
HIV ACTION	HIV final action based on results of HIV	number	-1 incomplete 1 HIV negative fit 4 HIV positive unfit
HBV ACTION	final action based on results of Hepatitis B	number	--1 incomplete 0 test not required 1 HBV negative fit 5 HBV positive unfit
SYP ACTION	final action based on results of Syphilis	number	0 test not required 1 Syphilis negative fit 3 Syphilis unfit
CXR ACTION	final action based on results of TB	number	4 Active ptb 5 old ptb 9 pending results

APPENDIX 2 – List of Variables used in notification system

Variable Name	Label & Units	Format	Codes
year	Year of test	yyyy	none
CASE_ID	Number of specific code for each notification. It is a unique number for each encounter with visa screening	Text & Numbers	None
DOB	Date of birth of applicants	Date: dd/mm/yyyy	
CI_Age	Calculated age	numbers	
Nationality	Nationality of patient. Each country is mentioned	Qualitative variable	
Nationality2	Nationality according to WHO regions		
CI_EMIRATESOFRESIDENCE	Emirates of residence of the patient	number	None
EMIRATE_TITLE	Emirates of residence of the patient	text	

CI_ADDRESSCITY	city of residence of the patient	number	
CITY_TITLE	city of residence of the patient	text	
EI_OCCUPATION	Occupation of patient	number	
OCCUPATIONNAME_EN	Occupation of patient	text	
EI_RESIDENCESTATUS	Status of residence	text	Resident expatriate UAE citizen visitor
CLI_DIAGNOSIS	Clinical diagnosis	text	
CLI_SUSBECTED	Suspected or confirmed	Text	Suspected Confirmed
CLI_DATEOFONSET	Date of onset	date	dd/mm/yyyy
CLI_PATIENT	Inpatient or outpatient	text	Inpatient outpatient
CLI_DETAILS	More details written about diagnosis	text	

NAME_EN	Hospital or facility name	text	
D_DIAGNOSIS	Reporting diagnosis	text	TB TB,HIV Rabies, TB TB, Extra pulmonary TB TB, hepatitis C
GENDER	Patient gender	text	Male female
DISCARD_REASON	Will be filled only if the case is discarded from the records	text	
MAJOR_DISEASE_SITE	Type of the disease	text	
TESTING_REASON	Reason of testing	text	Visa screening Self-referral Referral Other

			Contact screening
SYMPTOMS	Patient presenting symptoms	text	options
SYMPTOMS_OTHER	Other symptoms	text	options
CHEST_XRAY	Chest x ray finding	text	7 options: not done Abnormal not ptb Inactive ptb Low suspicion Medium suspicion High suspicion normal
CT_SCAN_RESULT	CT scan results	text	
TB_DIAGNOSIS_RREVIOUS	Previous diagnosis of tb	Number	0 1 yes 2

TB_DIAGNOSIS_PREV_YAER	Year of previous diagnosis	number	
TB_TREATMENT_PREVIOUS	Previous TB treatment received	number	0 1 2
TB_TREATMENT_PREV_YEAR	Year of previous treatment	number	
TB_TREATMENT_PREV_DURATION	Duration of previous treatment	number	
TB_CONTACT_PREVIOUS	History of contact with previous case	number	0 1 2
TB_CONTACT_PREV_YEAR	Year of contact with previous case	year	
BCG_VACCINE_HISTORY	History of BCG vaccine	number	0 1 2
BCG_SCAR_PRESENT	Presence of BCG vaccine scar	number	0 1 2
RISK_FACTOR	Risk factors	text	options
RISK_FACTOR_OTHER	Other risk factors	text	Free text

SPUTUM_SMEAR1	AFB results	text	Not done Negative positive
SPUTUM_SMEAR2	AFB results	Text	Not done Negative Positive
SPUTUM_SMEAR3	AFB results	text	Not done Negative positive
TB_PCR_TEST_RESULT	PCR result	Text/ number	-1 Not done Negative positive
TST	Tuberculin Skin Test	number	
IGRA_TEST	IGRA results	Text/ number	-1 Not done Negative positive
HIV_TEST_RESULT	HIV results	Text/ number	-1

			Not done Negative positive
SPUTUM_CULTURE	Culture results	text	Not done Negative Positive MOTT Contaminated
DIAGNOSIS_CATEGORY	Category of treatment	text	New Relapse Treatment failure Treatment interrupted Transfer in other
DRUG_SUS_ISNONIAZID	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_RIFAMPICIN	Susceptibility to drugs	text	Resistant

			susceptible
DRUG_SUS_PYRAZINAMIDE	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_ETHAMBUTOL	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_STREPTOMYCIN	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_ETHIONAMIDE	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_CAPREOMYCIN	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_AMIKACIN	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_RIFABUTINE	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_STREPTOMYCIN	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_CIPROFLOXACIN	Susceptibility to drugs	text	Resistant susceptible

DRUG_SUS_OFLOXACIN	Susceptibility to drugs	text	Resistant susceptible
DRUG_SUS_OTHER1	Susceptibility to drugs	text	Resistant susceptible
TREATMENT_CATEGORY	Treatment category	text	I II III

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CHAPTER 3

The implementation of the GeneXpert test for tuberculosis in the visa screening setting in Abu Dhabi, UAE, 2014-2016

Introduction

Advances in diagnostic technologies in the last decade have dramatically affected health care in many ways. Diseases that used to be difficult to diagnose, such as tuberculosis (TB), and the confirmation process took weeks due to the complexity of identification. Today, sensitivity testing has become simplified and now can be completed in days or hours. Tuberculosis is a challenging disease that is considered to be a global epidemic. According to the WHO Global TB Report, 2017, TB continues to be a high burden disease characterized by insufficient progress to reach its set targets. TB is the ninth leading cause of death world-wide and the leading cause from a single infectious agent, ranking above HIV/AIDS (1). In the year 2016, around 1.3 people died from TB among HIV negative persons and around 374,000 deaths were attributable to co-infection with HIV. Around 10.3 million people are estimated to have become infected with TB and around half of them were concentrated in five countries: India, Pakistan, Indonesia, China and the Philippines (1).

Drug resistance to TB continues to be a challenge in terms of treatment. In 2016 alone, approximately 600,000 cases of rifampicin resistance were reported and most were multi-drug

resistant (MDR) (1). Identifying resistance early enough to start the right treatment is important to control the transmission of the disease.

The history of identification of Mycobacterium Tuberculosis and the advances in diagnosis has been well documented. A German doctor, Robert Koch, first identified TB in 1882 and reported success in isolating the causative agent of tuberculosis (4). The Zeihl-Neelsen strain, or AFB, was first described by two German doctors in the 19th century using a special bacteriological strain to identify Mycobacterium Tuberculosis (5). The diagnosis of TB using traditional methods, such as Acid Fact Bacilli (AFB), is still practised across the globe. Despite its suboptimum sensitivity (~50%), this diagnostic test continued to be used for decades as the main diagnostic test, especially in high burden countries, as it was often the only test available (6). Koch was the first to grow the culture of Tuberculosis *in vitro* and demonstrate that the disease was an infectious agent by re-introducing the bacterial culture to un-infected animals and infecting them with the disease (4). TB culture continued to be the gold standard test for Mycobacterium Tuberculosis until very recently. The main challenge with the TB culture is the complexity of the steps required and the biosafety requirements that are hard to achieve in low income countries. In addition, the delay in waiting time for results (which can take weeks) is one of the challenges in using TB culture for diagnosis.

The rapid diagnosis of TB can help better control the disease and reduce the transmission of the agent. The use of rapid genetic identification of Mycobacterium Tuberculosis is an evolving technology that made the identification of cases much faster in addition to identifying the resistance in a one-step process. Many studies published in the period 2012-2013 showed the

positive value of GeneXpert/MTB test in the diagnosis of TB. Studies have reported that GeneXpert/MTB is a robust, simple-to-use test with high accuracy results in comparison to culture (10).

The Visa Screening Service is one of the important elements of disease control in Abu Dhabi, United Arab Emirates. The upgrade of the service is a continuous process to ensure the best outcomes. The program was upgraded in 2008 by the adoption of the best available international guidelines in the diagnosis and early detection of priority infectious diseases, including HIV and TB. This included the adoption of an electronic system that captured all tests and results. It is integrated within a central unit of the Department of Health (DOH). The integration of the DOH and several screening centers was useful in providing comprehensive data for monitoring and evaluating the service. The DOH central team has issued detailed standards for visa screening services that defined the list of expected tests for any suspected cases and defined, in detail, the methods to be used for diagnosis, confirmation and reporting. AFB and culture were mandatory for all suspected cases with TB identified using Chest x-ray.

The main objective of this study was to identify the links between evidence and practice for the implementation of GeneXpert/MTB in tuberculosis screening settings. The study evaluates the performance of the GeneXpert/MTB test compared with culture pre- and post- implementation in visa screening centers in Abu Dhabi. A careful review of its accuracy was conducted in a pilot study to compare its sensitivity and specificity compared to culture and to define the algorithm of testing. This study reviews post-implementation data to assess the impact of the test on TB detection.

METHODS

Data sources

The study was conducted using two sources of data. The first dataset is a pilot study conducted in one central laboratory in the Disease Prevention and Screening Center (DPSC) in Abu Dhabi in 2013. The data include 239 samples checked for three types of tests: (1) AFB smear (2) TB culture, and (3) GeneXpert/MTB test.

The second source of data is from visa screening centers: cases suspected of having TB during the period 2013-2014. This includes one year of data (2013) before the implementation of the GeneXpert/MTB test and one year (2015) after the implementation of the test in screening centers. The year 2014 was an overlap in the transition period during the implementation of the new screening system.

The data include all three regions of the Abu Dhabi Emirate: Abu Dhabi, Al Ain and Al Dhafra. This includes 11 visa screening centers. Samples were shipped to 3 central labs for diagnosis and confirmation.

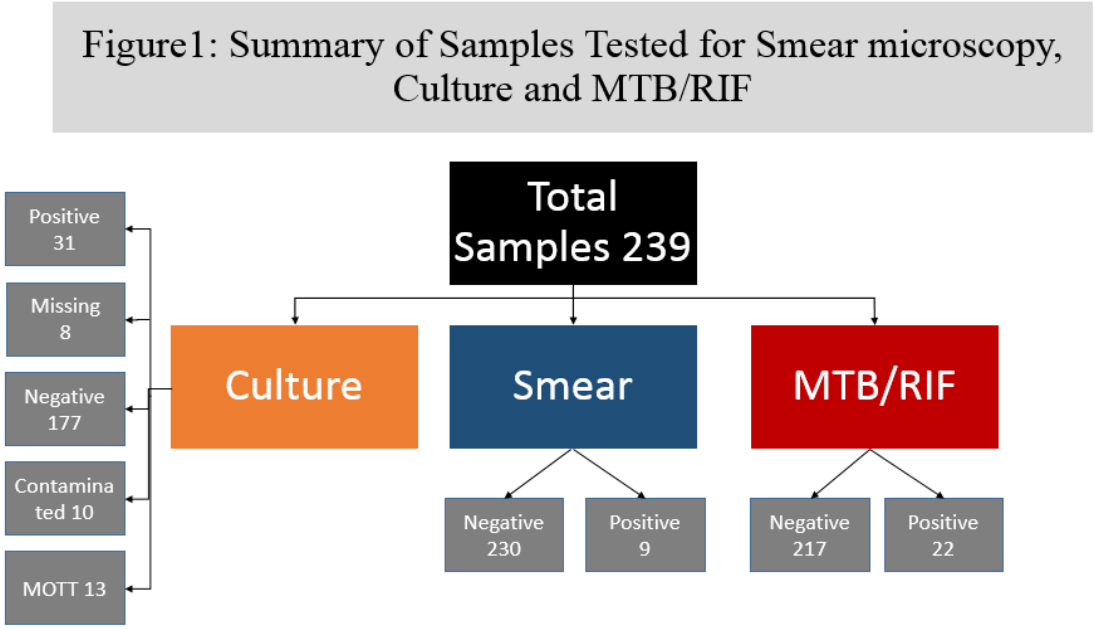
List of Variables Used

The initial analysis was conducted on pilot study data using the following variables: Sample ID, AFB results, PCR: results of Xpert/MTB Test, and Culture: results of culture test. The second dataset has variables listed in Appendix 1 with definitions and values for each variable.

DATA ANALYSIS

Data analysis was conducted using Excel and STATA software version 11.2 (Stata Corp, College Station, Texas, USA). Retrospective descriptive analysis was used to address sensitivity, specificity, PPV and NPV of each test. The calculation of confidence interval for each test was carried out to examine the significance of the findings. The comparison of GeneXpert/MTB and culture was conducted for the total pilot sample (239 samples) and then calculated for subgroups (AFB smear positive and AFB smear negative). Figure 1 shows a summary of the pilot study samples used in the analysis. The second step of the analysis included a review of actual implementation data to examine changes in the detection of TB over time (pre-implementation and post-implementation). In addition, a review of the drug sensitivity data for the year 2015 was conducted for both tests. Logistic regression for TB confirmation over time was conducted to determine if there was a significant change in case detection over the same period.

Figure 1 Summary of Samples Tested for smear microscopy, Culture, and MTB/RIF



Exclusion and Inclusion Criteria

Samples missing TB culture results (n=8) were excluded from the analysis. Results for TB culture reported as MOTT (n=13) or determined to be contaminated (n=10) were considered negative.

For the Pilot Phase, all specimens tested were from sputum samples collected in the visa screening setting from suspected cases of TB. Samples included in the study were checked for sputum quality and were at least 5 ml. Samples were processed using the Zeihl-Neelsen method of acid Fast staining technique for microscopy. Processing for direct GeneXpert MTB/RIF (Cepheid, Sunnyvale, California) testing was performed according to the manufacturer's instructions. Culture was conducted using Bactic MGIT 960 liquid culture.

In the period prior to GeneXpert MTB/RIF implementation, all suspected cases for TB by chest X-ray were referred for sputum collection (3 samples were collected for each patient) and then

AFB smear microscopy and culture were performed. Figure 2 shows a summary of the TB detection algorithm prior to GeneXpert MTB/RIF.

During 2014, a change in the algorithm was implemented to include GeneXpert/MTB/RIF in the testing (See Figure 3).

Figure 2: Summary of algorithm used for Testing and confirmation of all suspected TB cases in visa screening centers, 2013-2014.

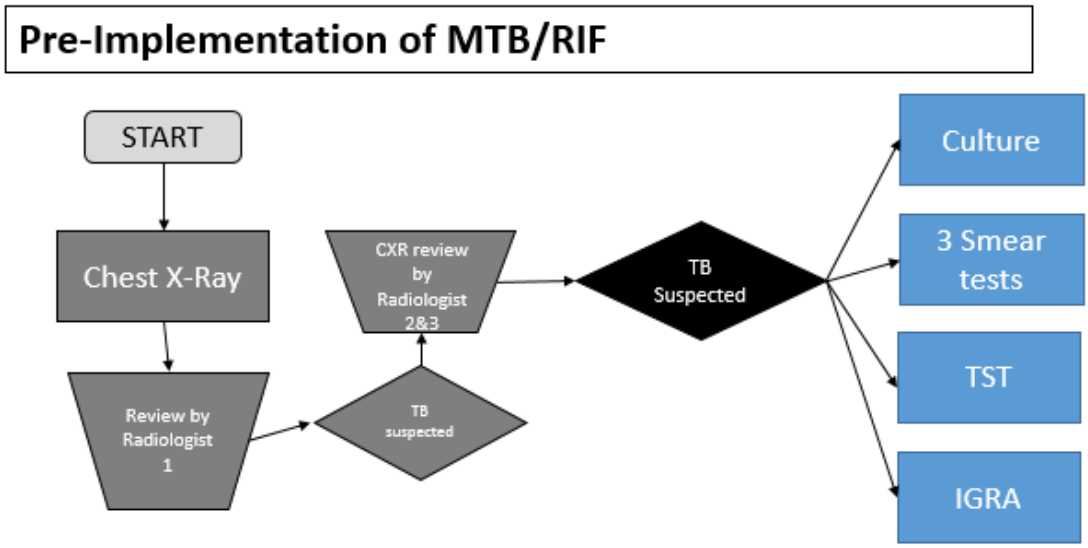
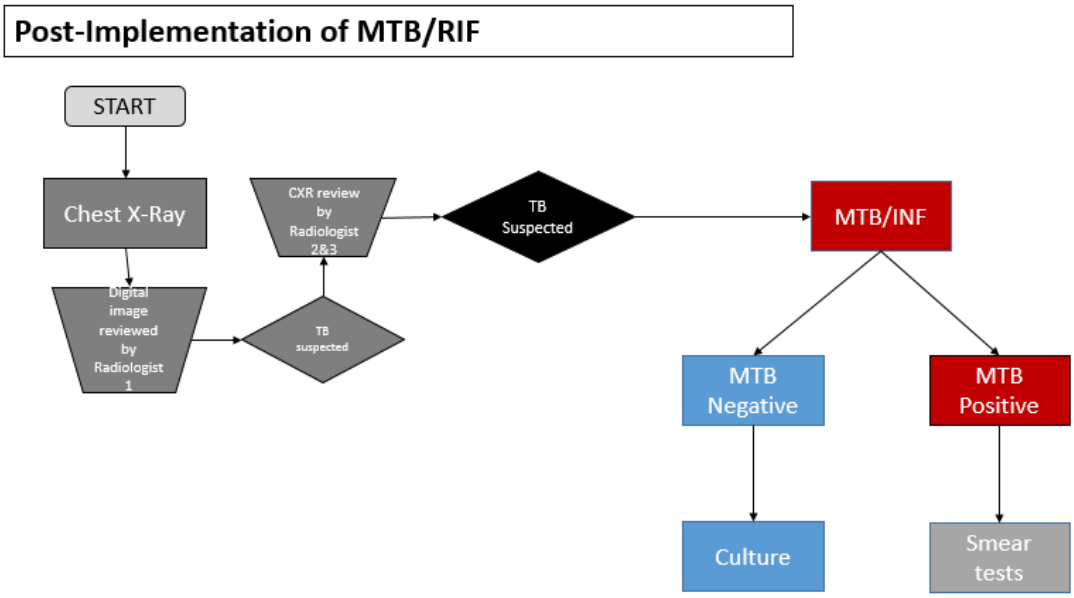


Figure 3: summary of algorithm used for testing and confirmation of all suspected TB cases in visa screening centers in 2014-2015.



RESULTS

Section A

Pilot Phase

The characteristics of the pilot study samples are shown in Table 1. Overall 249 samples were processed. The proportion of culture positive samples was 13% of the total samples tested. The proportion of GeneXpert/MTB positive was 9.2%. A total of 8 samples (3.3%) had missing culture results and were excluded from the analysis. Only 9 samples were found to be smear positive, and among those, 88.9% (8/9) were culture positive and 88.9% (8/9) were GeneXpert/MTB positive with identical results.

The majority of samples were smear negative (230 samples) and among those, 10% were culture positive (23 samples) and 6.1% were GeneXpert/MTB positive (14 samples).

Table1: Summary of Samples used and tested for Smear, Culture and MTB/RIF

Table1: Summary of Samples used and tested for Smear, Culture and MTB/RIF (Pilot Phase)

	Total samples	Culture positive(%)	Culture negative (%)	Culture missing (%)	MTB/RIF positive(%)	MTB/RIF negative(%)
Overall	239	31 (13)	200 (83.7)	8 (3.3)	22 (9.2)	217 (90.8)
Smear positive	9	8 (88.9)	1 (11.1)	0	8 (88.9)	1 (11.1)
Smear negative	230	23 (10)	199 (86.5)	8 (3.5)	14 (6.1)	216 (93.9)

The overall sensitivity of GeneXpert/MTB was found to be 51.6% (95% CI: 33.2-69.8). The specificity was 97.5% (CI: 94.5-99.1). The Positive Predictive Value (PPV_ was 76% (CI: 52.8-91.8) and the Negative Predictive Value (NPV) was 93% (CI: 88.7-96.0). The performance of the test for smear positives was very accurate with 100% Sensitivity, Specificity, PPV and NPV. However, the sample was small and the P value was not statistically significant.

Whereas, for smear negative samples, the sensitivity of GeneXpert/MTB was 34.8% (CI: 16.4-57.3). Specificity was 97.5% (CI: 94.3-99.1). PPV was 61.5% (CI: 31.5-86.1) and NPV was 93% (CI: 88.7-96). All comparative results of GeneXpert/MTB versus Culture are shown in Table 2.

Table2: Comparison of Xpert MTB/RIF and culture diagnostic test results in relation to smear microscopy (Pilot Phase)

Table2: Comparison of Xpert MTB/RIF and culture diagnostic test results in relation to smear microscopy (Pilot phase)

	Sensitivity (95% CI)	Specificity(95% CI)	PPV(95% CI)	NPV(95% CI)
Overall	51.6%(33.1-69.8)	97.50%(94.3-99.1)	76.20%(52.8-91.8)	93%(88.7-96)
Smear negative	34.80%(16.4-57.3)	97.50%(94.3-99.1)	61.50%(31.5-86.1)	93%(88.7-96)
Smear positive	100%(63-100)*	100%(25-100)*	100%(63-100)*	100%(25-100)*

*one sided, 97.5 Confidence Interval

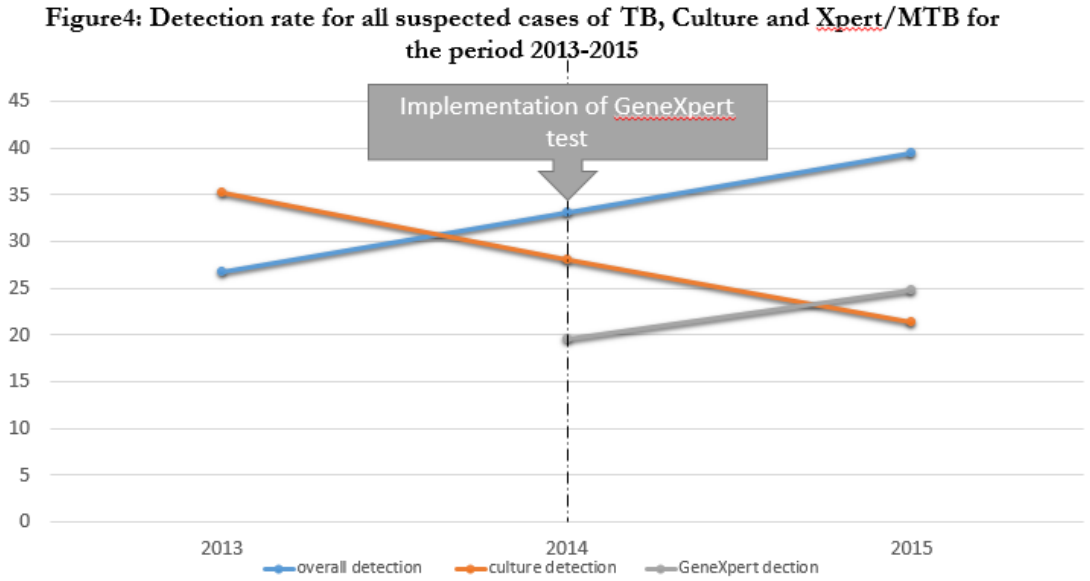
Section B

Post Implementing GeneXpert MTB/RIF

The summary of the annual TB detection rate for suspected samples who tested positive shows a statistically significant (P <0.001) increase from 2013 to 2015. This clearly shows improvement of overall detection of TB cases after the implementation of GeneXpert/MTB in 2015 in comparison to 2013.

Figure 4 shows a summary of TB detection of the different tests over time. When observing detection using culture samples, it is clear that detection declines with time starting from 35.2% in 2013 to 21.44% in 2015 (P value<0.001). The year 2014 is the transition period when the detection methods were changing. In comparison to culture, GeneXpert/MTB detection increased over time: GeneXpert/MTB detection in 2014 was 19.5% whereas in 2015 it was 24.7% (P value was not statistically significant).

Figure4: Detection rate for all suspected cases of TB, Culture and Xpert MTB/RIF 2013-2015



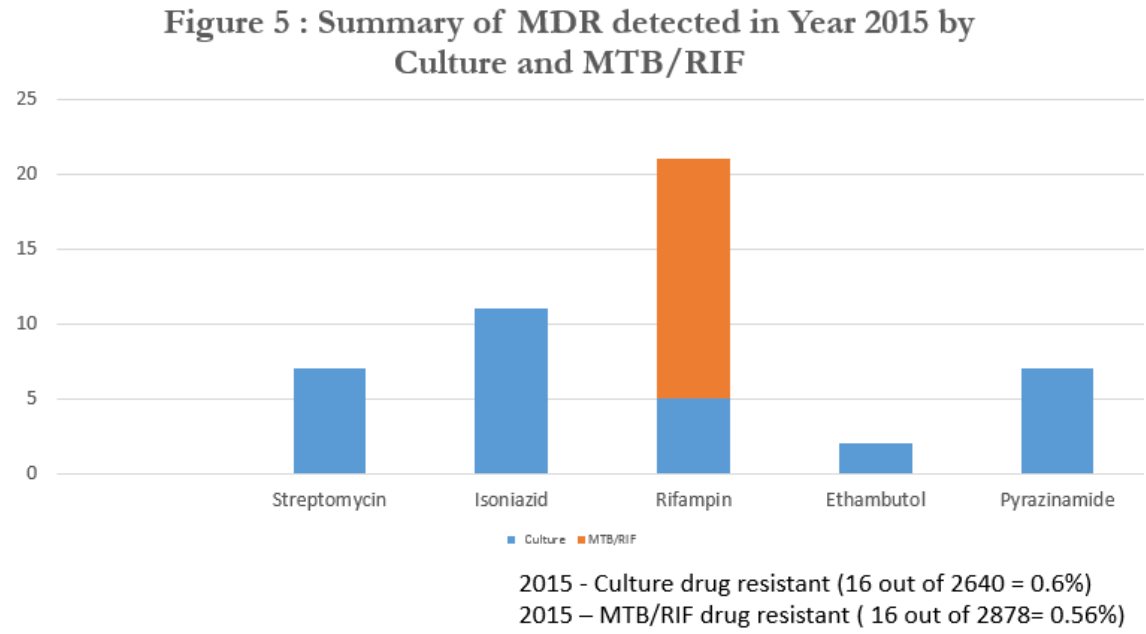
Section C

TB Antimicrobial Resistance

The review of antimicrobial resistance data in 2015 after the implementation of GeneXpert/MTB is presented in Figure 5. Around 0.6% of samples tested with culture were found to be resistant and around 0.56% of samples tested with GeneXpert/MTB were found to be Rifampicin resistant. The benefit of early detection of GeneXpert/MTB for rifampicin resistance before the treatment enrollment was not captured in the data. The culture provided a more detailed resistance profile for first line medications, as are shown in Figure 5. Around 11 samples were found to have resistance to isoniazid using culture: the highest in comparison to other anti-TB medications (7 samples resistant to Streptomycin, 7 samples resistant to Pyrazinamide, 5

resistant to Rifampicin and 2 resistant to Ethambutol). 13 out of 16 samples were MDR compared to only 3 samples that showed single resistance to Pyrazinamide.

Figure 5: Summary of MDR detected in 2015 by Culture and Xpert MTB/RIF



DISCUSSION

In the pilot study, the accuracy of GeneXpert/MTB was evaluated in comparison to culture and the accuracy of the results. The results of the study showed high specificity of the test in comparison to culture for the overall samples at 97% (95% CI: 94.3-99.1) and lower sensitivity 51.6% (95% CI: 33.1-69.8), which is consistent with findings from others (8, 10, 12, 37). The test showed better performance in smear positive samples with identical findings in comparison to culture results with 100% sensitivity, specificity, PPV and NPV. However, the sample of smear positives was very small and could not show statistical significance as there was very low statistical power. This finding is confirmed by other studies. A sensitivity of 98-100% of smear

positive samples was reported in a multi-centric study (12). Therefore, the use of GeneXpert/MTB in smear positive cases is equivalent to culture and can replace it.
Several studies concluded that the rapid PCR method is a valuable, cost-effective and alternative tool for quick diagnosis of active tuberculosis in varying clinical specimens (9). One of the important values of GeneXpert/MTB is the reduced time interval for diagnosis and treatment in comparison with traditional methods of diagnosis. This will eventually lead to reduced patient defaulting during the investigation period and improve treatment coverage (6). The long-term impact of PCR in improving overall morbidity, more rapid treatment and the reduced tuberculosis transmission is under observation. In addition, the reduced amount of sample handling using simple techniques can certainly reduce the biohazard requirements for laboratory technicians and reduce the further use of culture in routine diagnostic settings (6).

Based on these study findings, the TB testing algorithm was updated for visa screening medical testing and the new algorithm was adjusted for the differences in GeneXpert/MTB for both the sensitivity and specificity of the test. The low yield of negative GeneXpert/MTB can be improved by adding culture as a second step for the negative samples on GeneXpert/MTB to detect false negative cases. Using this order of testing will enable program managers to detect most positive cases earlier by GeneXpert/MTB. The minority of cases missed due to lower sensitivity can still be picked up by culture.
The review of this study confirmed that the algorithm used in Visa Screening Centers after 2014 shown in Figure 3 is useful and can be implemented in similar settings.

The review of TB detection rates over time in Abu Dhabi showed improvement after the adoption of the new testing algorithm. This confirms the findings of other studies, where the Rapid PCR method using GeneXpert/MTB increased detection and treatment of multidrug-resistant tuberculosis. It is now considered a valuable, cost-effective and alternative tool for quick diagnosis of active tuberculosis in different clinical specimens (9).

This study did not cover the mean time for detection for both Culture and GeneXpert/MTB. This is covered in other studies and showed a major difference as the mean time for GeneXpert/MTB was 0 days (IQR 0-1), compared to 1 day (IQR 0-1) for AFB smear and 16 days (IQR 13-21) for liquid culture. This can be even longer for solid culture that takes around 30 days (IQR 23-43 days) (12).

Studies show that GeneXpert/MTB increases detection and treatment of multi-drug resistant tuberculosis (6). GeneXpert/MTB test sensitivity for rifampicin was reported to be 94.4% (236 of 250) (12). Another study reported that MTB/RIF testing correctly identified 200 of 205 patients (97.6%) with rifampin-resistant bacteria and 504 of 514 (98.1%) with rifampin-sensitive bacteria (37). The review of post-implementation results in 2015 in Abu Dhabi provided a positive value of early detection of rifampicin and more than half of those cases were detected by MTB/RIF. However, since the test does not detect other types of drug resistance, this could lead to some missed cases.

This study did not address the cost impacts of the test in comparison to culture. This was covered by other studies that showed that GeneXpert/MDR can lower the overall cost of MDR cases that

required treatment due to the fact that the test will provide early results of resistance and can support physicians to provide the right drug combinations in the early stages and will have better outcomes (44).

There are some challenges associated with the study. One was the small number of smear positive specimens that could not be changed due to the fact that the study was conducted on specimens collected in the past. Confirmation of the study finding was reassuring. However, if the smear positive samples had been higher, this could have strengthened the finding of test accuracy in smear positive samples. The study of post-implementation data included results after one year, which can be continued for subsequent years to measure the impact over a longer period. The results of detected pre- and post-implementation were assumed to be directly due to GeneXpert/MDR being implemented in 2014 (the transition period). The methodology of testing in the labs for visa screening centers was assumed to be similar because all of them followed the same standards of testing defined by DOH.

CONCLUSION

In our study, GeneXpert/MDR was found to increase TB detection after the implementation of the test in visa screening settings. The use of GeneXpert/MDR as a confirmatory test for suspected cases identified by chest x-ray has been previously reported by other studies to be effective and useful and this is confirmed by this study. In addition, the study provided some guiding algorithm for the use of GeneXpert/MDR, not fully replacing culture due to the limitations of the test (low sensitivity results in comparison to culture). The algorithm suggests the use of culture for GeneXpert/MDR negative specimens to improve the overall yield of confirmation.

APPENDIX 1 – List of variables used in Visa screening system

Variable Name	Label & Units	Format	Codes
Year	Year of test	**yyyy**	
APP_NO	Number of specific code for each applicant of visa screening. It is a unique number for each encounter with visa screening	Text & Numbers	None
APPLICANT NATIONALITY	Nationality of visa screening applicants. Each country is mentioned	Nationality list	None
Nationality2	Nationality according to WHO regions	AFRO EMRO South East Asia Western Pacific American Europe	1-6
Date of birth	Date of birth of applicants	Date: dd/mm/yyyy	None
Age	Age in years	number	=INT(YEARFRAC(E3; K3))
VISA TYPE	New or renew in the country	text	New or Renew

GENDER	Male or Female	text	Male or female
APPLICANT OCCUPATION	Occupation of the applicant	text	List of occupations
APPLICANT CATEGORY	Occupation groups based on Visa screening requirements	text	A Bi Bii
AFB SMEAR 1st	AFB smear results first sample	Text/number	PH040 0 per 300 fields PH041 1 per 300 fields PH042 2 per 300 fields PH043 +1 PH044 +2 PH045 +3
AFB SMEAR 2nd	AFB smear results second sample	Text/number	PH040 0 per 300 fields PH041 1 per 300 fields PH042 2 per 300 fields PH043 +1 PH044 +2 PH045 +3
AFB SMEAR 3rd	AFB smear results third sample	Text/number	PH040 0 per 300 fields

			PH041 1 per 300 fields PH042 2 per 300 fields PH043 +1 PH044 +2 PH045 +3
TB CULTURE 1st	Culture results 1st sample	Text/number	PH047 No growth PH048 MTB PH049 MOTT PH050 contaminated
TB CULTURE 2nd	Culture results 2nd sample	Text/number	PH224 No growth PH228 MTB
TB CULTURE 3rd	Culture results 3rd sample	Text/number	PH238 No growth PH239 MTB
TB PCR	TB PCR results gene expert test		450 Negative 451 Positive 453 Indeterminate
RIF	Rifampicin resistance		

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CHAPTER 4

Evaluation of TB Control Program in Abu Dhabi Using the WHO Framework for Conducting Reviews of Tuberculosis Programs

INTRODUCTION

The health care system in UAE has undergone major structural changes in the last decade to improve the health care delivery system. The first change was in 2005, with the split of local health authorities from the federal Ministry of Department of Health Abu Dhabi (DOH), defined as the regulatory body for the Emirate of Abu Dhabi. It regulates the local health care system in coordination with the Federal Ministry of Health (MOH). DOH is also responsible for the design and implementation of all public health programs in Abu Dhabi. In addition, the introduction of the mandatory health insurance system for all residents in 2006 was the second milestone change that influenced the Tuberculosis Control Program. A new era of electronic surveillance systems for infectious diseases started around 2010 to strengthen the reporting and actions for infectious disease programs. TB was identified as one of the priorities of the infectious diseases program and the continuation of TB services in the health care facilities was one of the prime concerns. "The vision for DOH was defined to Ensure Reliable Excellence in Healthcare. The vision guided major reforms and the Department of Health Abu Dhabi (DOH) was created to regulate all healthcare sectors."(1) Furthermore, Abu Dhabi Health Care Services (SEHA), the largest

public services provider, was created as the government body responsible for the delivery of health care services in the Emirate of Abu Dhabi.

The regulation framework in the UAE is developing very rapidly to accommodate the rapid changes in the healthcare system and the level of economic development in the country. Some regulations issued and/or updated have had a major influence on the TB control program. These include Law no. (14) for the year 2014 concerning the control of infectious diseases, Ministerial Decree no. (7) for the year 2008 concerning medical testing for expatriates for residence or work, and Ministerial Decree no.(5) for the year 2016 concerning medical testing for expatriates for residence or work. In addition, local regulations for the Emirate of Abu Dhabi were important in encouraging updates in the TB control program. One of the local regulations that had a direct impact is: Law no. (23) for the year 2005 concerning health insurance in the Emirate of Abu Dhabi and the implementation of regulations. (4)

The assurance of the best public health programs was a joint effort between the regulator and the provider. During this period, the tuberculosis control program in Abu Dhabi underwent major changes in adapting to the overall changes in the health care system. These changes included the automation of the reporting of TB, improved infection control measures within the healthcare facilities, and the introduction of the TB DOT program in primary health care facilities. Prior to 2010, all care provided to TB patients was limited to secondary care hospitals and the private sector which had no defined role in the management or diagnosis of TB.

The Global Strategy for the TB Control program defined by WHO was also evolving and undergoing revisions and updates to promote health in the target countries to control the disease better. In 2006, WHO developed the Stop TB Strategy. Targets and goals were set and among them was the Millennium Development Goal 6: " The strategy aimed at ensuring TB burden falling by 2015 that prevalence and mortality rates are halved by 2015 compared with a baseline of 1990."(2).

The Stop TB Strategy had six major components:

1. Pursue high-quality DOTS expansion and enhancement
2. Address TB/HIV, MDR-TB, and the needs of poor and vulnerable populations
3. Contribute to health system strengthening based on primary healthcare
4. Engage all care providers
5. Empower people with TB and communities through partnership
6. Enable and promote research

This strategy was further revised in 2014 and updated in the 2015 Global TB Strategy. The strategy aims to end the global TB epidemic with targets to reduce TB deaths by 95%, to cut new cases by 90% between 2015 and 2035, and to ensure that no family is burdened with catastrophic expenses due to TB. It sets interim milestones for 2020, 2025, and 2030.

The strategy creates a roadmap for governments to adapt and implement with high-level commitment and financing as follows:

> "It reinforces a focus within the strategy on serving populations highly vulnerable to infection and poor health care access, such as migrants. The strategy and resolution highlight the need to engage partners within the health

> sector and beyond, such as in the fields of social protection, labor, immigration and justice. The resolution requests the WHO Secretariat to help Member States adapt and operationalize the strategy, noting the importance of tackling the problem of multidrug-resistant TB and promoting collaboration across international borders. WHO also recommended monitoring the implementation and evaluating progress towards the milestones and the 2035 targets" (5)

The rapid development of TB diagnostics also occurred in the same period and more accurate and faster diagnostic tests such as GenXpert and other rapid molecular tests were gradually developed and used to provide information about disease activity. Those tests saved a lot of waiting time (between 4-6 weeks waiting for culture results) and now results are available within days in most cases.

With all of those changes locally and globally, it is important to have a clear understanding of the Tuberculosis Control Program in Abu Dhabi so as to understand the changes in the program and devise recommendations on how to improve program performance and achieve targets set by the WHO strategy to End TB. The evaluation is a prospective, qualitative review. It uses semi-structured interviews conducted during 2017 to gain a better understanding of the program at various levels of the health care system including primary care, secondary care, diagnosis, management and monitoring at local levels. The main objectives of the evaluation were:

- To improve the effectiveness of the national TB program and share outcomes with international community.

- To provide policy makers with a clear overview of program performance and suggest improvements to current practice
- To provide guidance for strategic planning for TB control
- To strengthen the collaboration between key stakeholders in the health care system that have direct impact on the TB program
- To identify challenges in meeting the objectives of the national TB program
- To assess whether progress has been made towards achieving national, regional and global targets
- To assess the performance of the programme in delivering strategic interventions, assess how well services are delivered, and assess any inequities in access to and quality of care

METHODS

Forming the working group

The study is prospective using qualitative, semi-structured interviews and utilizing WHO existing tools to evaluate program elements in various health care settings. These include screening, diagnostic and management facilities in addition to the central program unit in Abu Dhabi. To ensure a reliable evaluation process, a team of evaluators was formed from the following stakeholders:

1- Academic institution expert specialized in public health (1 member)
2- Ministry of Health program leads of TB (3 members)
3- Private hospital consultants on pulmonology or infection control (3 members)

4- Public Hospital consultants in infectious diseases or infection control (5 members)
5- Health Authority Abu Dhabi TB program leads or audit team (4 members)
6- Visa Screening Centers (3 members)
7- Laboratory experts in microbiology (1 member)

The first meeting included a comprehensive review of program components and evaluation objectives. The group divided into subgroups to review the WHO checklist and revise the contents of the questions to be used in field evaluation.

The second meeting included review of expected deliverables and finalization of the checklist. Content not applicable to the local healthcare system was removed. This included assessing the implementation of the practical approach to lung health (PAL) which is not implemented in the health care system but rather focusses on the DOT program. Some questions were added to check the awareness of health care providers about DOH DOT standards.

Before conducting the field visits, all evaluators were trained in standardizing the process and conducting the questionnaire.

Various questionnaires were used based on the type of service provided. For example, screening facilities played a major role in active case-finding and diagnosis and referral, but not in management stage. Questions related to patient management from those facilities were excluded.

The field visits were arranged to observe the infrastructure and functions of each organization based on the checklist provided. The evaluators were divided into groups of two and assigned to visit facilities. This exercise was helpful for stakeholders to identify the roles of other stakeholders and challenges arising in various settings.

The following areas were covered in the evaluation:

1. Management of the national TB program
2. Local strategic plan for TB prevention, care and control
3. TB case-finding
4. Quality-assured diagnoses made by TB laboratories
5. Quality of TB diagnoses
6. Management of TB cases
7. Programmatic management of drug-resistant TB
8. TB/HIV collaborative activities
9. Patient adherence to TB care
10. Management of anti-TB medicines and supplies
11. Recording and reporting
12. Activities to address childhood TB
13. Assessing infection control practices related to TB in the facilities
14. Public–public and public–private mix approaches
15. Engagement of civil society, non-governmental and community organizations
16. Assessing human resources development

Figure 1: Summary of the Review stages and timeline

Stages of Evaluation

The study was conducted over a one-year period starting with an overview of existing international models of evaluation for TB control program elements and a comprehensive literature review. The WHO framework of evaluation was selected as the main reference for evaluation. Checklists suggested by WHO were revised to ensure consistency and applicability to the system. The second phase included selection of the evaluation team. Selection was based on expertise in the area of infection control, laboratory, infectious disease consultants, pulmonary consultants, epidemiology or health audit experience. The group was drawn from the private and public sectors from local and national levels. It was considered that a group mix would provide broader diversity of information together with a comprehensive overview of the existing system.

Geographical distribution

The evaluation covered all three regions of Abu Dhabi Emirate: Abu Dhabi (Central region), Al Ain (Eastern region), and Al Dhafra (Western region). This was intended to ensure a comprehensive picture of the program given that each area has different settings, requirements and expectations. The selection of major health care providers in each region sought to represent health care system volumes, patient access, patient mix, and age groups

Data Analysis

All checklists completed by the evaluators were collected and entered in Excel and used for the analysis. The main program used for the evaluation was Excel. Data quality was evaluated by

assessing completeness and accuracy of information. Each checklist was filled and reviewed by two evaluators who visited the facility to ensure accuracy of information captured.

Facilities were grouped by region and roles within the health care system. Two distinct checklists were used in the interviews:

A- Local regulatory level:

Evaluation of TB control program planning, surveillance and monitoring in Health Authority Abu Dhabi

B- Public and private diagnostic facilities:

Evaluation of performance against expected roles in various stages of patient management pathways including case detection, management and isolation, diagnosis, and follow-up. Further grouping and analysis were conducted separately for screening facilities because their role was different from other diagnostic facilities and the expectations were different.

Analysis of Checklists

The facilities questionnaire included 218 questions grouped according to the stage of patient care. Some questions were skipped during interviews if not applicable for the facility according to their roles. For example, in visa screening facilities there is no in-patient management because they are referred to secondary care facilities.

Stages of the Study

Analysis of visa screening results began with assessments of trends over time, frequency distributions, and tabulations. A summary of new and renewal results was given and included positive culture, PCR, and smear results. In addition, an analysis and calculation of mean and median values for different variables was carried out. The review of visa screening applicants was based on residency status (new applicants versus renewals) based on previous research that confirmed substantial differences in TB rates between both types.

Scope of Evaluation

The analysis was first conducted for each dataset separately (pulmonary TB notifications and extra-pulmonary notifications). Data quality was reviewed and included the completeness of fields and the selection of fields useful in the analysis. Frequencies and distributions of age groups and nationalities were calculated. It is important to highlight that this method of passive reporting from hospitals included additional clinical details such as risk factors, drug resistance and previous history of the disease. Although not all fields were fully completed, most cases had complete lists of variables needed.

RESULTS

The questionnaire was a very help tool to structure the visits and to review all the elements of the TB control program. The revised checklists are included in Appendices 1 and 2. All completed

forms have been collected and analyzed, then followed by a discussion with the evaluation group. The following sections are a summary the main findings.

Section A

Local Regulatory Level of TB Control Program

The central level of the program is the heart of the whole system and it is a critical component of the evaluation. This section was evaluated by experts in TB epidemiology for the National Program and an academic partner. The TB control program follows the National TB strategy in the UAE. There are clear national regulations for TB control defining requirements of reporting at the local level. There are also clear standards defining the role and responsibilities of each organization within the health care system at local level. The national and local policies exclude defined targets of reduction in the next 5 or 10 years, in line with WHO global targets. There is no national or local policy on HIV/TB collaborative activities and this is one of the areas that requires improvement. The local standards define the requirements for diagnosis, reporting and case-management of patients with TB produced by the Communicable Diseases Department (CDD). One of the gaps identified, treatment for children, was not clearly defined in terms of patient management and prophylactic management. The focus was exclusively on adult patients. Some case definitions in the standards should be updated based on current WHO case definitions.

Reporting from Local to National level is done on a regular basis based on a set of templates defined by the national program coordinator monitoring the situation. Figure 2 shows the conceptual framework for TB control program elements and includes some of the KPI measures to monitor program performance.

The program also defined the funding for TB management for patients excluded from the national insurance scheme. The team conducts multiple training activities for health care workers and coordinates supervisory visits to follow program implementation. One of the areas of improvement is to include training materials for TB management in children. In addition, the staff in the central unit can be trained on how to conduct supervisory visits to ensure consistency. After each supervisory visit, a summary report is prepared for the management indicating strengths, weaknesses and recommendations.

One of the program strengths is the electronic reporting system that captures all of the cases from suspicion to final outcome of management. This comprehensive database is not available in other entities in the country and can be shared with other local or national entities. The electronic program is a very helpful tool to identify the actual performance of each facility. The analysis of the data is automatically generated to provide the program lead real-time information and captures the program KPIs. Table 2 shows how KPIs are monitored on a regular basis and used in setting useful local targets to guide future evaluation of program performance.

The human resources capacity seemed to be an issue in the central level due to the limited number of staff to follow up the TB contact tracing process and patient adherence to regular follow-ups in TB DOT clinics.

The feedback about TB cases reporting is shared with stakeholders by quarterly summary reports as part of the Communicable Diseases Bulletin. A collaboration among various stakeholders within the TB control program seems to exist within the healthcare setting. Very limited information, however, is available about collaboration with other stakeholders outside the healthcare system. This area can be strengthened in the future in terms of TB awareness activities or the funding of TB control program activities.

The activities related to TB research are limited to academic institutions. There is no link with the local health department to ensure that research priorities are met.

There is no awareness plan for TB to address knowledge gaps or stigma that might be related to the disease. The engagement of patients, communities or civil society organizations was not in the plan. The main highlighted issue was lack of budget for TB activities and awareness. There are very limited efforts to link with other sectors that may be affected by TB such as labor or social services. There is good link of awareness and shared activities established with immigration and social policy services.

Figure2: Conceptual framework for TB control program.

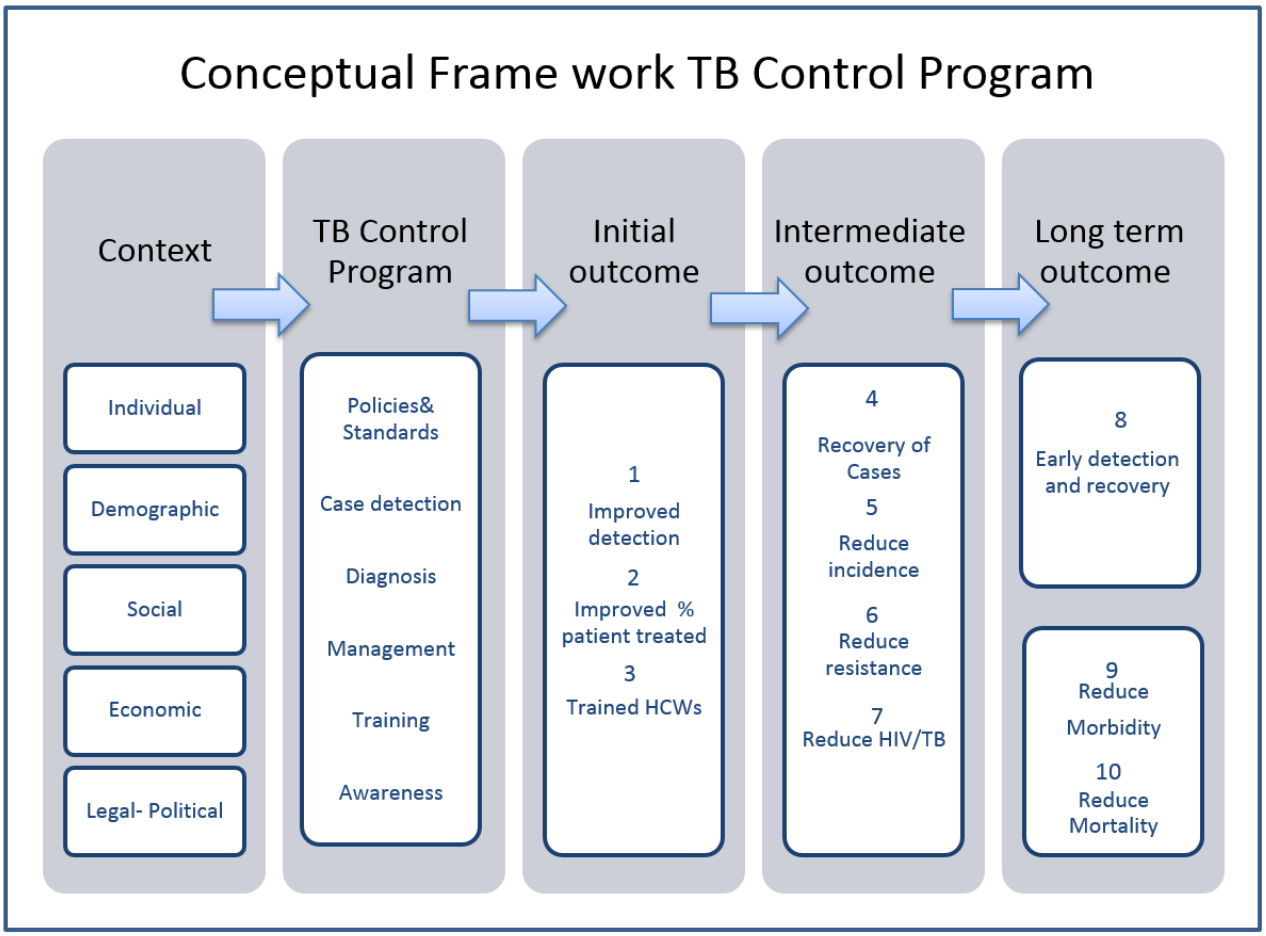


Table 1: summary of KPIs for TB control program in Abu Dhabi.

Reference No.	Indicator	Numerator	Dominator	Source of Data	Measure
Immediate outcome Indicator					
1	Proportion of Patient diagnosed with TB from total screened	Number of patients diagnosed with TB	Number of patients in visa screening screened for TB	Visa Screening data	
1	Proportion of Patient diagnosed with TB from suspected	Number of patients diagnosed with TB	Total Number of patients suspected	Notification data	
2	Proportion of patients started treatment from confirmation	Number of patients started stage 1	Total number of cases confirmed	Notification data & visa screening	
3	Proportion of health care facilities trained for TB	Number of facilities trained	Total number of facilities licensed	Program	
Intermediate Outcome Indicator					
4	Proportion of Patient recovered	Number of patients completely recovered	Total number of patient confirmed with TB	Notification data	
5	Proportion of patient with HIV diagnosed with TB	Number of patients with HIV diagnosed with TB	Total number of TB cases confirmed	Notification data	
6	Proportion of patient with anti-microbial resistance	Number of patients diagnosed with TB with anti	Total number of TB cases confirmed	Notification data	
Long-term Outcome Indicator					
7	Proportion of Patient diagnosed with TB from total screened	Number of patients diagnosed with TB	Number of patients in visa screening screened for TB	Visa Screening data	
8	TB incidence	Number of new cases of TB diagnosed in 1 year	Total number of Abu Dhabi population	Notification data + visa screening	
9	TB mortality	Number of new cases of TB who died in 1 year	Total number of Abu Dhabi population	Notification data + visa screening	

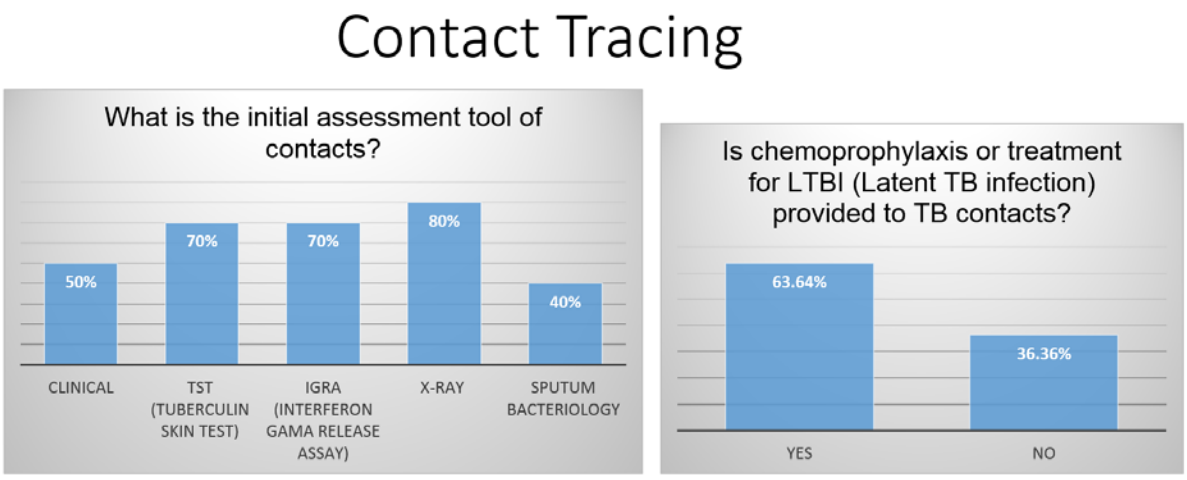
Contact Tracing Process

This is a shared activity among the local regulatory authority, screening centers and other health care facilities. It is an important step in TB control. Figure 3 outlines TB contact tracing in Abu Dhabi. Based on the questionnaire, approximately 63% of facilities provide contact-tracing services for people exposed to TB. The private sector seemed to be not included in this process. In addition, more than one tool is used to assess closed contacts, including chest x-ray in 80% of

facilities. In addition, TST and IGRA are both used to evaluate contacts in 70% of the facilities. Sputum smear and clinical assessment also used for evaluation.

The categories of contacts included in chemoprophylaxis treatment included elderly, immunocompromised, children below 5 years of age and contacts with latent TB. Chemoprophylaxis for children is limited to secondary care hospitals and the access is very difficult for all contacts. This is one of the gaps to be improved.

Figure 3: Contact-tracing summary in health care setting in Abu Dhabi Emirate.



	Abu Dhabi								Eastern Region		Western Region
	Primary 1	Secondary 1	Secondary 2	Private 1	Private 2	Private 3	Private 4	Secondary 4	Secondary 3	Private 5	Secondary 5
Contact Tracing	✓	✓	✓	✗	✗	✗	✗	✓	✗	✗	✓

Section B

Visa Screening Centers

The epidemiology of TB in Abu Dhabi described in the previous chapter defined case detection of expatriates as one of the program priorities due to the high proportion of expatriates compared to that of the local population (nationals) especially since most come from countries with a high burden of TB. Most TB cases diagnosed every year are detected from visa screening centers. There are detailed standards at the local level that define the expected screening requirement and details of diagnosis and confirmation required for every suspected case.

There is consistency in terms of diagnosis methods across the centers in alignment with local standards. There are central labs for referral of samples for confirmation that have the capacity to conduct smear testing, using GeneXpert and culture. In terms of drug sensitivity, only rifampicin resistance is conducted as part of GeneXpert test for smear positive cases, which is acceptable for screening facilities. For smear negative cases, culture is done to rule out TB and no drug sensitivity testing is done for those cases. Table 2 notes the performance of visa screening centers for each level of TB patient pathway. The evaluators commented on the high standard of labs available at the central level. In addition, induction negative pressure rooms were observed with high standards and clear monitoring. A nurse was routinely available. Staff are aware of infection control measures for TB and good practice was noted during the visits. One evaluator commented on a men's changing room for X-ray: it was a confined space allowing close exposure to other people and could increase the risk of TB transmission from symptomatic cases.

One visa screening center provides TB DOT treatment services in addition to case detection. Concerning training, staff in two out of the three facilities visited confirmed recent awareness

sessions of TB management and control. Training for staff in those centers is very important to ensure adherence to infection control measures and the continuous development and update of knowledge about TB case detection and management.

Table 2: Summary of evaluation survey for visa screening centers.

Survey summary: Visa Screening Centers

	Center A	Center B	Center C
Algorithm for screening and confirmation of TB	✓	✓	✓
Sputum collection	✓	✓	✓
Culture/ Rapid PCR	✓	✓	✓
Drug sensitivity	Only rifampicin	Only rifampicin	Only rifampicin
Referral for treatment	✓	✓	✓
TB treatment	✓	✓	✗
Do You Provide DOT in the center	✗	✓	✗
Training	✓		✓

Section C

Primary and Secondary Health Care Facilities

A total of 11 health care facilities in the review included 5 public secondary care hospitals, 5 private hospitals and 1 primary health care center, as shown in figure 4. These facilities were distributed in the following regions:

8 facilities in Abu Dhabi

2 facilities in Al Ain

1 facility in the western region.

Case Finding

Case finding is usually done based on clinical presentation and x-ray findings in all facilities and the suspicion of a case with cough for more than two weeks in absence of other causes. Local standards define the required set of tests for a diagnosis of TB including sputum smear, culture and GeneXpert test and there seems to be good access to those tests across the system. Private hospitals refer culture samples for confirmation in public, designated labs due to the absence of this facility in the private sector. All health care facilities seem to be aware of the reporting requirement to the local regulatory authority. Around 73% of facilities routinely evaluate TB among HIV positive patients.

Suspicion of TB in patients who have had a cough for more than two weeks is done in 60% of the facilities. In addition to clinical suspicion, 75% of the facilities reported using radiological

findings in CXR and, to a lesser extent, CT is used by approximately 60%. Further, around 60% of the facilities request culture for the diagnosis of TB.

A diagnosis of extra-pulmonary TB is mainly done using clinical presentation in 88% of the facilities. Taking a biopsy for histopathology is also done in 88% of the facilities. Around 78% of facilities send the sample for AFB smear and culture.

The facilities are aware of the reporting requirements to the DOT TB central unit using the electronic notification system. All interviewed personnel have a valid account in the notification system and are aware of reporting requirements at different facility levels. 50% of interviewed facilities said that the reporting of TB was easy while 50% said it was moderately easy to do.

Sputum Collection

The collection of sputum samples is a very important technique that needs to be well defined due to the risk of TB transmission during the collection procedure. Evaluators commented that most health care facilities have a designated space for sputum collection: either a negative pressure room or a location outside the building. One major finding concerning sputum collection in primary health care centers is that a designated space is generally not identified: patients were normally asked to use public toilets for the collection of sputum. This poses a real risk to other patients and needs to be brought to clinic management attention. The observation of the sputum collection is done by various health care professionals such as doctors, nurses or lab technicians in various settings. The provision of detailed guidance of the requirements for rooms for sputum collections together with the provision appropriate educational material might be helpful to improve current practice.

Case Management and TB Medication:

It is clear from the evaluation that the treatment of TB is limited to public hospitals. Referral is usually initiated by private hospitals. Evaluators highlighted the issues of patient bed availability in public hospitals and the non-availability of medication in the private sector. The availability of anti-TB medicine in the private sector is not clearly defined although the general understanding is that treatment is limited to public hospitals.

There is a noticeable gap in referrals for treatment from private to public hospitals due to the lack of bed availability in public hospitals. If a patient in the private sector is suspected of having TB, samples can be taken and sent for further diagnosis and confirmation. Patients are usually not admitted and there is no access to medication, even if active TB is suspected and the patient shows symptoms. Private hospitals reported difficulty in referring patients for admission to public hospitals.

Around 55% of facilities conduct drug sensitivity testing for confirmed TB cases and around 75% had a system to follow up results.

Health care professionals reported a good knowledge of DOH standards for TB management. In addition, some facilities developed their own guidelines or use the international guidelines published by CDC or WHO.

Around 60% of facilities call patients if they fail to come for collection of medication and follow up of defaulters is also done by the Central Department in DOH.

Possible reasons behind lack of patient compliance regarding TB medication was discussed. Professionals indicated that patients often discontinue treatment due adverse effects related to

medication. Other reasons are transportation issues, problems at work and the delivery of medicine.

It is noticed that all first lines are available in all facilities providing TB treatment and there is no issue regarding supply. However, only 50% of facilities have second-line medication available. In facilities which provide HIV treatment, it is clear that there is integration of management and prevention of TB. Patients with HIV are offered preventative Isoniazid therapy. They are routinely screened for TB at initiation of HIV treatment and also if they develop suspicious symptoms indicative of HIV.

Treatment of TB is partially covered by insurance and there is a co-payment required that is covered by the patient directly or by their sponsor. This is one of the issues for patients with low incomes such as ordinary workers, especially if they have MDR or XDR: the cost is high for such cases and cannot be afforded by some patients.

Around 55% of facilities reported that TB patients indicated that their families believed that TB could be cured. Some patients reported that TB was life-changing (15%) and that they suffered from stigma related to the disease (30%). Around 40% of facilities reported that patients feel stigmatized because of their disease.

TB in Children

The evaluation identified a major gap in service for preventative treatment in children. Most facilities are not aware that preventative therapy for TB is required for children under 5 years of age when exposed to a TB patient. There is a lack of counseling and educational services on

offer for children and their families to convince them about compliance of treatment. A diagnosis of TB in children is difficult and needs a lot of awareness and knowledge especially in primary health care settings. It is even more difficult to ensure the compliance of children for six to nine months of treatment. The lack of designated services with good access is one of the issues identified during evaluation. National and local guidelines only covered adults and did not elaborate about diagnosis, treatment or prevention of TB in children. Two tertiary care hospitals provide the treatment for TB in children with very difficult access, especially for expatriates.

Laboratory Capacity for TB Diagnosis

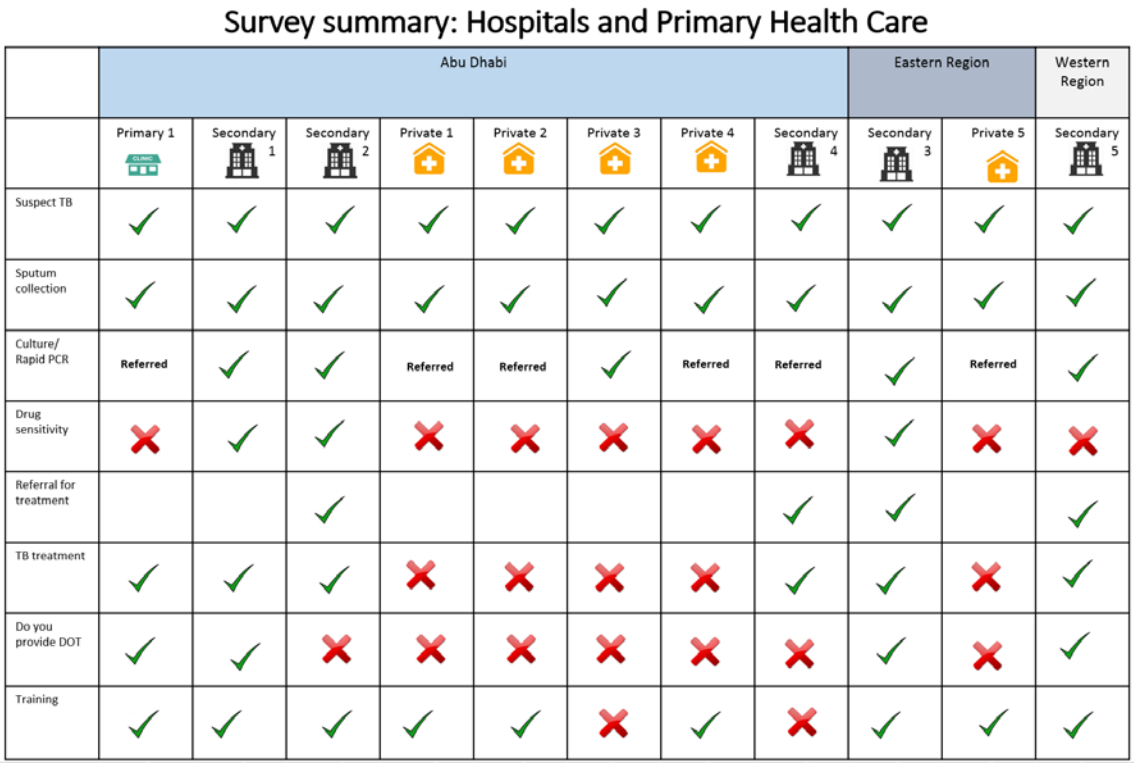
There are three main designated labs for TB confirmation. They have trained personnel to conduct TB smear, culture, and GeneXpert and baseline sensitivity testing. MDR sensitivity testing is available although no labs had full panel for testing XDR. This is an issue especially if the patient is not responsive to treatment and a change of medication is based on laboratory testing for second line medication. In some individual cases, samples are sent abroad for testing. Access to TB culture in the private sector is done through referral of samples to designated labs in the region and is similarly done for all suspected cases.

Infection Control Practices related to TB

The evaluation highlighted some of the strengths related to infection control practices such as the isolation of patients suspected of or confirmed with TB in a negative pressure room or separate rooms. The surveillance of TB among health care workers is established routinely in 65% of facilities evaluated. A practice breaching infection control noted in the reports was the use of

public toilets in one of the facilities for sputum collection. However, the majority of facilities had a designated area for sputum collection with negative pressure or hepa filter. The introduction of sputum facilities in visa screening centers was highlighted by evaluators as a model for good infection-control practice.

Figure 4: Survey summary in Hospitals and primary health care center.



DISCUSSION

This is the first comprehensive review of the program conducted at local level in Abu Dhabi. This review could be useful in supporting the program's development and improvement. This evaluation was conducted by various members of an evaluation working group using the checklists in Appendices 1 and 2 together with field visits to major health care facilities including both private and public providers. This evaluation could be a baseline for future evaluations to measure any change and performance in the TB control program. The UAE is included in the list of low burden countries based on the WHO Global Report, 2016. The UAE had a total burden of TB 1.6 per 100,000 population in 2015, a burden of HIV <0.1 per 100,000 population, and very low burden of MDR (0.17 per 100,000 population) (6). This report includes the most updated figures and is descriptive of TB epidemiology in the local population. Figures exclude the expatriate population and immigrants living in UAE who comprise around 80% of the total population. Most expatriates come from the top ten countries with a burden of TB such as India, Pakistan, Philippines, Indonesia, and China (6). The first paper provided a detailed report about the epidemiology of TB in the UAE capital, Abu Dhabi, and provided details about the high-risk group population. Most of the evaluations published focused on the reporting system and the quality of data (23). Another evaluation of the TB program in India focused on patient compliance to TB DOT treatment. It found that older, male patients tended to default from TB treatment and the study discussed barriers to TB Treatment (18, 27, 29). Various elements of TB control program were covered based on WHO requirements of a TB control program.

The WHO End TB Strategy aims to end the global TB epidemic, with targets to reduce TB deaths by 95% and to cut new cases by 90% between 2015 and 2035, and to ensure that no

family is burdened with catastrophic expenses due to TB. It sets interim milestones for 2020, 2025, and 2030" (7). In the following sections, WHO strategy principles and the main pillars in the local perspective will be reviewed to compare the strengths and weaknesses in various elements of the TB control program. This will provide policymakers with a view of program performance and provide insights into opportunities for improvement.

The Main Principles of WHO Strategy

1. Government stewardship and accountability, with monitoring and evaluation

The control program focused on the establishment of a strong surveillance system by electronic reporting covering all different stages of the disease until recovery: a useful tool for continuous monitoring of the disease. Throughout the review, it was noticed that a strong collaboration existed between health care providers and the DOH central team, and that there was cooperation with limited stakeholders such as social services. The monitoring of TB management outcomes is a very crucial element of program success. There are some barriers for patients to complete the treatment course such as inadequate level of awareness about the disease, complications of medication, and difficulties accessing the TB DOT service. Some new effective ways of monitoring TB medication compliance uses mobile applications and video recording of patients that can sometimes replace the need for physical visits to clinics.

2. Strong coalition with civil society organizations and communities

The collaboration with external stakeholders can be further strengthened by mapping all organizations that may be impacted by the disease or have a shared interest. Based on the mapping of key stakeholders, the team can further initiate communication to strengthen the

relationship and get support in areas that require coalitions. An example of possible partners will be major employers in the private sector or non-profit organizations. The coordination with HIV programs and stakeholders is another area that can be emphasized and strengthened.

3. Protection and promotion of human rights, ethics and equity

It is clear from the review that access to health care services in public hospitals is provided to all patients. The insurance system provides partial coverage for TB treatment and the government provides coverage for patients who do not have insurance coverage. The next step recommended is a revision for patients who have a co-payment and have limited income to cover additional costs. It is very important to cover low-income patients as they are a high-risk group and because this might lead to an increase in defaulters and the risk of further TB in the community. It is important to revise access details by mapping patients and services to make sure that DOT services are provided in areas with high numbers of TB cases. Some gap areas identified during the evaluation is workers' camps where there is no local public clinic available. A possible solution for this issue is to revise the private services provided locally and to contract them to provide TB DOT treatment. It is clear that the management of TB is currently limited to public providers. This could be adequate if they have the capacity to take all patients to ensure access. It is clear, however, that the public health sector has a limited capacity and resources and will be required. Support from the private sector will also be required especially in areas where there is no public service provision. It is important to provide TB medication to private hospitals and train staff on the handling and management of TB cases. It is important to monitor the percentage of TB defaulters and have a detailed analysis and to study the reasons behind any discontinuation of medication.

4. Adaptation of the strategy and targets at country level, with global collaboration

It is important to develop a continual revision program in line with the WHO End TB Control Strategy and its regular updates. The review done in Abu Dhabi covers a local program and it is important to conduct a similar exercise at national level.

WHO End TB Strategy Main Pillars

1. Integrated, patient-centered care and prevention

It is clear from the review that the early diagnosis of TB has been encouraged in both public and private facilities with a clear role and responsibility matrix in the TB DOT standard of care. Most facilities are aware of case definitions and how to suspect and report TB. In addition, most staff received training about the TB program. A study conducted in Oman noted that there is inadequate knowledge of TB among GPs in the private sector compared to GPs in the public sector (9). The procedure for the diagnosis of TB is very well established and there is a clear pathway for referrals of samples for confirmation. There is a clearly identified mechanism for referral of samples from the private to the public sector. The inclusion of the private sector in the management of TB needs to be done to improve access in areas not served by public hospitals.

There is a clear gap in drug-susceptibility testing for second line medication that needs to be revised to ensure that there is at least one lab capable of conducting second line sensitivity testing.

The TB screening program is widely used. It covers high-risk groups and provides data about active and latent tuberculosis. Positive cases are referred for treatment and admission. In

addition, contact tracing is conducted among those at risk of infection who require prophylactic medication. There are two gaps identified that can improve the outcome and have a huge impact in the overall rate of TB. First, prophylactic treatment is currently not provided for all latent TB cases identified at first screening. Second, provide access to preventative services for children. This currently provided by selected secondary care hospitals with very limited access and capacity.

The treatment of all patients with TB is covered by the national insurance program. The UAE government provides for patients with no insurance coverage. There is, however, a co-payment associated with TB treatment for some patients: those with drug-resistant TB and those requiring patient support.

A study conducted in India found that the main reasons for poor adherence to TB medication were poor knowledge about TB, forgetfulness, and the lack of outreach and educational programs for TB (33). A review conducted to understand barriers to TB management adherence in immigrant and high-risk populations listed the main barriers to be fear, anxiety, denial and stigma. In addition, the use of incentives was suggested as the best intervention to improve access to care and compliance (34). The reason behind the lack of patient compliance reported in this evaluation is adverse effects related to medication. The main reason for defaulting in treatment is transportation issues. Other barriers reported were problems at work, delivery of medicine, and stigma of the disease. Some suggested interventions are improvement in access for TB management, the provision of awareness programs for TB, and the discussion of possible incentives for the treatment of high risk groups.

2. Bold policies and supportive systems

A TB control program is one of the health priority areas at both national and local level. Most efforts are currently focused on screening and early detection. There is engagement with health care providers in the public and private sectors. Engagement with other stakeholders beyond the health care system is crucial and can be improved upon as they can actively participate in TB awareness and support programs.

3. Intensified research and innovation

Research into TB is very limited in the Gulf region. This could be the case due to the low level and support of research in the medical field in general, both regionally and locally. Regional data available to this study were very limited. Local research is required into regional TB incidence to gain a better understanding of the issue and to optimize the implementation and impact of a control program. The development of new strategies and tools for an effective TB control program is required.

APPENDEX 1

TB Evaluation Framework for health care facilities

Name of facility:
Date of the visit: / 5 / 2017
Time: from To

Visiting team:

	Name	Place of work	Mobile No.	signature
1				
2				
3				
4				

Staff from the facility interviewed:

	Name	Place of work	Mobile No.	signature
1				
2				

3				
4				
5				
6				

Report submitted to CDD/HAAD on / /2017

Received by: Name & signature

Part (1) Assessing TB Case-finding

Location: specialized and non-specialized outpatient clinics at health facilities
Staff to be met: Health-care workers (such as doctors, nurses, medical assistants and clinical officers)

A. Identifying people suspected to have TB

1. How do you identify a suspected TB case? **MCQ**
    a. Clinically
    b. radiologically
    c. laboratory
    d. others _____

2. What are the clinical criteria for suspecting TB (for example, do you ask patients if their cough has lasted for longer than 2 weeks)?
    a. Yes
    b. No
3. Mention the other clinical criteria for suspecting TB
    _____
    _____
4. Do you evaluate patients who are HIV-positive?
    a. Yes
    b. No
5. Have the physicians and other health-care workers been trained to identify and manage people suspected of having TB, including those suspected of having drug-resistant TB?
    a. Yes
    b. No (Go to Section B)
    c. I don't know (Go to Section B)
6. When was the training provided?
    Date (dd/mm/yyyy) _____
7. Who provided it? (Trainer's organization) **MCQ**
    a. HAAD
    b. SEHA
    c. Same facility,
    d. Other entity (mention): _____

B. Managing people suspected to have TB

8. Do the health-care workers follow the available algorithms (DOT – DOH standard including the clinical care pathway) or standard operating procedures when assessing patients? (Check and verify facility documentation like patient medical records)
    a. Yes
    b. No
9. Are the forms required to refer the patient for the following available (electronic or paper forms)?

a. Testing with sputum microscopy, yes No
b. chest radiography yes No
c. Xpert MTB/RIF (PCR) test Yes No

10. Do the health-care workers use a combination of screening tools (radiological and lab. investigations) and assessment procedures (history and clinical signs and symptoms)?
    a. Yes
    b. No

C. Managing Sputum:

11. What is the procedure for sputum collection? **MCQ**
    a. Expectoration mechanism
    b. Induction
    c. Others e.g. Gastric aspiration, bronchoscopy, (Mention please) _____

12. Where is sputum collected?
    a. Negative pressure room in the lab
    b. Isolation room in the ward or ER
    c. Negative pressure room in the ward or ER
    d. Others (mention please):_____

13. Observe whether sputum is collected in:
    a. Well ventilated areas or
    b. Outside the building.
    c. NA (No sputum collected during the time of visit)

14. Are the infection control precautions taken during sputum collection? (Check and verify)
    a. Yes
    b. No

15. Are the sputum-collection containers adequate (never experienced stock out)?
    a. Yes
    b. No

16. Are they labeled properly (Name and MRN of patient, date of collection)? Recommended to check collected sputum sample if possible.
    a. Yes
    b. No

17. Is sample processing lab services available (is sputum sample examination for TB disease is available at the facility lab)?
    a. Yes (skip the next question)
    b. No

18. If the samples are not processed in the same facility, how often are specimens transported?
    - daily
    - weekly
    - others:_____

19. Who is usually responsible for instructing the patients how to produce sputum?
    a. Clinic physician
    b. Clinic nurse
    c. Lab technicians
    d. Others:_____

D. Managing drug-resistant TB

20. Is there a system for following up patients suspected of having drug-resistant TB?
    a. Yes
    b. No

c. I don't know

21. Is there a register where patients referred for drug-susceptibility testing (DST) are recorded?
    a. Yes
    b. No
    c. Others, mention please _____

E. Managing X-ray:

22. Is chest radiography available?
    a. Yes (answer next question)
    b. No (skip next question)
23. Is chest radiography used?
    a. Yes
    b. No
24. Are people suspected of having TB referred elsewhere for chest radiography?
    a. Yes (answer next question)
    b. No (skip next section)
25. How does the referral procedure work? (Recommended to ask the transfer nurse if available)
    a. easy
    b. moderate
    c. difficult to handle

Please describe briefly:_____
_____

F. TB contact investigation

1. Are the procedures for screening and assessing TB contacts clearly defined?
    a. Yes
    b. No
    c. I don't know

2. Are algorithms available for health-workers to use?
    a. Yes
    b. No
3. Have staff who should carry out contact investigations been identified and are their roles well defined?
    a. Yes
    b. No
4. Is there an information system (or register) that can be used to monitor and evaluate contact-investigation activities?
    a. Yes
    b. No
5. What is the initial assessment tool of contacts? **MCQ**
    a. clinical
    b. TST (Tuberculin Skin Test)
    c. IGRA (Interferon Gama Release Assay)
    d. X-ray
    e. Sputum bacteriology
    f. Others (mention please) _____

6. Is chemoprophylaxis or treatment for LTBI (Latent TB infection) provided to TB contacts?
    a. Yes
    b. No
7. If yes, to which categories of contacts is chemoprophylaxis or treatment for LTBI provided? MCQ
    a. Children less than 5 years
    b. elderly
    c. immunocompromised
    d. LTBI
    e. Others_____
8. What medicine of chemoprophylaxis is provided to contacts? **MCQ**
    a. INH
    b. Rifampicin
    c. Others_____
9. Are there any follow up steps for those contacts enrolled in chemoprophylaxis? (e.g. there is a register or excel sheet or any form of follow up to follow their compliance with the treatment schedule)
    a. Yes
    b. No

Part (2) Assessing quality-assured diagnoses made by TB laboratories

Location: intermediate laboratory or Health care facility laboratory
Staff to be interviewed: laboratory manager or director, laboratory technicians

1. What is the general operation of the visited laboratory? **MCQ**
    a. Diagnostic
    b. Screening
    c. Researches
2. How would this lab classified?
    a. Primary healthcare lab.
    b. Secondary healthcare lab
    c. Tertiary healthcare lab.
    d. Reference lab
3. What is the laboratory's catchment area? **MCQ**
    a. Abu Dhabi island and middle region
    b. Al Ain region
    c. Al Dhafra / Western region
    d. Others (mention please) _____
4. What is the general population size served by this lab? Estimated if available: (_____)
5. How many other (public & private) laboratories are there (for this catchment population) in the catchment area served by this lab. (_____)
6. How many technicians work in the laboratory? (_____)
7. How many staff are qualified/ experienced in sputum microscopy? (_____)

8. How many sputum specimens are processed? if the samples are not processed at the same facility lab please mention zero (verify)
    a. Daily (_____)
    b. weekly (_____)
    c. monthly (_____)
9. Has laboratory staff followed safety measures for laboratory works? observe and verify
    a. Yes
    b. No
10. Is the airflow appropriately directed? Check and verify (observational) specially safety cabinet:
    a. Yes
    b. No
11. Are the smears prepared and stained, and reagents stored, in an appropriate area? Check and verify (observational)
    a. Yes
    b. No
    c. Not applicable
12. Does the laboratory receive sputum specimens from an outpatient clinic or other facility?
    a. Yes
    b. No **Go to question 14**
13. If yes,
    a. How is the specimen delivered to the laboratory?
    _____
    b. How is the specimen stored before being sent to the laboratory?
    _____
    _____
    c. How long, on average, is the specimen stored before being sent to the laboratory?
        i. Hours, mention (_____)
        ii. Days, mention (_____)
    d. How long does it take for the specimen to reach the laboratory?
        i. Hours
        ii. Days, mention(_____)
    e. How long does it usually take for results to be reported once a specimen has been received?
        i. Hours
        ii. Days, mention (_____)
    f. How are results reported to the clinic or the health-care facility?
        i. On the system (electronic)
        ii. Fax
        iii. Email
        iv. Mail
        v. Others, mention please _____
14. How many cultures were performed during the last year (2016) or other relevant period of time?

(_____)

15. How many cultures were positive? For the same period
(_____)
16. What proportion of TB cases is confirmed by culture? For the same period
(_____)
Numerator: number of positive cultures identified during a specified period
Denominator: total number of cultures performed during the same period
17. How many DSTs were performed during the last year (2016) (or other relevant period of time)?
(_____)
18. Is Xpert MTB/RIF testing available?
    a. Yes
    b. No **End of this section**
19. Is there a clear algorithm or standard operating procedure for staff to follow when using the Xpert MTB/RIF test?
    a. Yes
    b. No
20. How many Xpert MTB/RIF tests were performed during the last year (2016)? (or other relevant period of time)?
(_____)
21. How many Xpert MTB/RIF tests were positive for TB? For the same period
(_____)
22. How many were positive for rifampicin resistance? For the same period
(_____)

Part (3) Assessing the quality of TB diagnoses

Location: Health care facilities providing TB care.

Staff to be interviewed: health-care staff providing clinical care

1. Are standards for the diagnosis and case-management of patients with TB available in the facility?
    a. Yes
    b. No
    c. Not sure
2. If yes, who issued these standards? **MCQ**
    a. HAAD
    b. SEHA
    c. CDC/US
    d. WHO
    e. Others (mention please) _____
3. Do the health professionals at the health facilities visited use (DOH-DOT) standard to establish the diagnosis of TB? (It will be appropriate to discuss this with the staff and to look at the files of patients diagnosed with TB at the health facility.) staff to be interviewed and records to be verified
    a. Always
    b. frequently
    c. Sometimes
    d. Not sure

4. Is the diagnosis of smear-positive pulmonary TB established by following the procedures specified in the mentioned guidelines?
    a. Yes
    b. No
5. Are pulmonary TB cases with sputum smear positive confirmed by:
    a. Sputum culture test
    b. Xpert MTB/RIF test
    c. Both
    d. None
6. Which of the following criteria are used to diagnose smear-negative pulmonary TB? MCQ
    a. History of prolonged exposure to active PTB case
    b. Clinically
    c. Radiological (chest x-ray)
    d. Other radiological imaging (example: CT chest)
    e. Bacteriological culture
    f. Others (mention please) _____
7. What procedures are used to establish the diagnosis of extra-pulmonary TB? MCQ
    a. Clinically
    b. Radiological imaging
    c. Biopsy for histopathology
    d. Disease site sample sent to direct smear microscopy
    e. Disease site sample sent to culture for AFB (Acid Fast bacilli)
    f. Others (mention please) _____

8. Are histopathology tests commonly used to establish the diagnosis of extra-pulmonary TB?
    a. Yes
    b. No

9. For what proportion of patients with extra-pulmonary TB was the diagnosis based on the results of histopathology? (Check patient records or HCF documents related to Extra Pulmonary TB patients, **the reference year is 2016**)
    a. All suspected extra Pulmonary TB patients
    b. Majority (More than 50% of the suspected cases)
    c. Few (not many but more than one of the suspected cases)
    d. None of the suspected extra Pulmonary TB patients.
    e. Not sure

10. For what proportion of patients with extra-pulmonary TB was the diagnosis based on the results of bacteriological tests? (Check patient records or HCF documents related to Extra Pulmonary TB patients, **the reference year is 2016**)
    a. All suspected extra Pulmonary TB patients
    b. Majority (More than 50% of the suspected cases)
    c. Few (not many but more than one of the suspected cases)
    d. None of the suspected extra Pulmonary TB patients.
    e. Not sure

Part (4) Assessing activities addressing childhood TB

Location: Health care facilities providing TB care services including case detection, reporting, management, or follow up.

Staff to be interviewed: health-care staff providing TB care services.

1. Are the standard operating procedures or guidelines on childhood TB available at the health facilities visited? (observe)
    a. Yes
    b. No
    c. Not applicable, mention why:_____
2. What are the common clinical presentations of childhood TB at the health facilities visited? (check records)

    _____

    _____

    _____
3. What criteria are used to establish the diagnosis of childhood TB? (Pediatrician need to be interviewed if available) **MCQ**
    a. Clinical
    b. Radiological (chest x-ray)
    c. TST
    d. IGRA in children above 5 years of age
    e. sputum smear and culture for Mycobacterium TB
    f. Sputum Xpert MTB/RIF test
    g. Others (mention please) _____

4. Are the procedures to establish the diagnosis of TB in childhood clearly described in the patients' files? (check patient's file)
    a. Yes
    b. No
    c. Not applicable
5. Is isoniazid preventative therapy (IPT) administered to children (below 5 years) exposed to active TB?
    1. Yes
    2. No
    3. Not applicable (no children screened as contacts to active TB case in 2016)
6. Is isoniazid preventative therapy (IPT) administered to children who are HIV-positive but do not have active TB.
    a. Yes
    b. No
    c. Not applicable (no HIV-positive cases seen in 2016 in childhood)
7. Since it is hard to convince a child to take many anti-TB medications for 6 - 9 months and it is stressful for a child to be put on isolation for TB, is there any evidence of providing social and psychological support for children diagnosed to have TB? (check records)
    a. Yes
    b. No
    c. Not applicable (no cases seen in 2016 in childhood)
8. Are school staff nurse communicated and educated to coordinate the treatment course at school:
    a. Yes
    b. No

c. Not applicable (no cases seen in 2016 in school age)

Part (5) Assessing the management of TB cases

Location: Health care facilities providing TB care services including case detection, reporting, management, or follow up.

Staff to be interviewed: health-care staff providing TB care services.

1- Is patient information entered in the electronic infectious disease notification using HAAD recommended case definitions? (check notifications from the facility or check records)
   a. Yes
   b. No
2- Are the criteria used to categorize TB patients aligned with these definitions? (check notifications from the facility or check records)
   a. Yes
   b. No
3- Is there a complete address or other information for contacting each patient (in TB register or on Electronic infectious disease notification submitted by the facility on HAAD system? Check notifications or check records)
   a. Yes
   b. no
4- Are patients' treatment cards or its copies kept at the health facility where the treatment is provided? observe
   a. Yes
   b. No
5- Are the cards kept under appropriate conditions (e.g.in patient file)? observe
   a. yes
   b. No
6- Are TB confirmed cases tested for HIV?
   a. Yes
   b. No
7- How is treatment for TB administered?
   a. Using DOT strategy
   b. Using other routine procedure **Go to question 17**

8- Is this a DOT providing facility?
   a. Yes
   b. No **Go to question 17**

9- How many patients are registered to receive DOT on the day of visit?
   (_____)
10- At what place is the DOT delivered?
   a. At a hospital,
   b. At a health care facility,
   c. others: _____
      i. in the community,
      ii. within the patient's family home,
      iii. in the school
      iv. in the labor camp

11- For how long is the DOT treatment provided?
   a. Throughout the whole course of treatment,

b. Only during the intensive phase
c. Until the patient discharged from the visited hospital

12- Are there differences for delivering DOT to patients with MDR-TB?
a. Yes
b. No, it is the same c. Not applicable, why _____

13- If yes, please clarify how it is differs: _____
_____

14- Are treatment supporters used? Treatment supporter is a person could be a family member, friend, partner, school health nurse, labor camp nurse or any other person who can observe the patient during swallowing his ATT medication regularly)
a. Yes
b. No **Go to question 17**

15- Are treatment supporters trained or educated on how to observe patient under DOT?
a. Yes, how? _____
b. Not trained

16- Are they supervised by a health care worker from the visited facility?
a. Yes, how? _____
b. No

17- Are the follow up investigations done on time as per DOT – HAAD standard (on initial diagnosis, 3 months, and at the treatment completion) check patient records
a. Yes, on time
b. Yes, done but not on time as per DOT standard
c. No follow up investigations done **Go to question 20**
d. Not applicable **Go to question 20**

18- What type of follow up investigations done at 3 months of starting treatment? **MCQ**
a. Clinical assessment
b. Sputum smear
c. Sputum culture
d. Chest x-ray
e. Other (mentioned) ----------

19- What type of follow up investigations done at treatment completion: **MCQ**
a. Clinical assessment
b. Sputum smear
c. Sputum culture
d. Chest x-ray
e. Others (mention please) ----------

20- Do TB treatment cards include information on:

a. case notification number	☐ Yes	☐ No
b. referral to other facility	☐ Yes	☐ No
c. date of starting ATT under DOT program	☐ Yes	☐ No
d. date of starting continuation phase,	☐ Yes	☐ No
e. regime used in the initial phase	☐ Yes	☐ No
f. regime used in the continuation phase	☐ Yes	☐ No

21- What is the procedure for recording which anti-TB medicines have been administered? (Review the procedure for ticking boxes on TB treatment cards.)
_____
_____
_____

_____
_____

22- Were patients who defaulted or failed treatment appropriately managed? and how? (Review the treatment cards for a selection of patients.)

_____
_____

23- What is the process used for patients who are transferred to another DOT clinic (to continue treatment in another HCF in another region)?

_____
_____
_____

24- What is the process used for patients who are transferred to another TB management unit (to continue treatment in another emirate i.e. transfer in)?

_____
_____
_____

25- Is there a form that is used when a patient being treated is transferred out (outside UAE)?

a. Yes , provide copy of sample and describe:
   _____
b. No

26- Are the treatment outcomes for patients who have been transferred communicated to the initial basic management unit?

a. Yes
b. No
c. I don't know

27- Is there a system for contacting patients who do not collect their medications or present to a health facility on their scheduled appointment?

a. Yes
b. No **Go to question 31**

28- How tracing of defaulters (loss to follow up) is carried out? Check records and provide evidence (e.g. copy of calling registration) **MCQ**

a. Calling the patient
b. Calling the treatment supporter
c. Calling a closed family member to the patient
d. Calling the sponsor
e. Others_____

29- Who conducts the default tracing? **MCQ**

a. IC nurse
b. DOT focal point
c. Appointment section at the HCF
d. Patient affairs
e. Others (mention please) _____

30- When is the default tracing undertaken?

a. After each no-show visit
b. After the 2nd no-show visit
c. After the 3rd no-show visit

d. Others (mention please) _____

31- Is psychosocial support offered to patients to ensure adherence to treatment?
   a. Yes,
   b. No **End of the section**
32- Is such a support offered to all patients or only to specific categories of patients?
   a. To all patients
   b. To specific categories of patients (when there is a need for psychosocial support)
33- How is such support funded?
   a. Self-pay
   b. Health insurance company
   c. Sponsor of the patient
   d. Civil organization, mention _____
   e. Others mention _____
   f. Not funded

Part (6) Assessing the programmatic management of drug-resistant TB:

Location: Health care facilities providing TB care services including case detection, reporting, management, or follow up.

Staff to be interviewed: Review the programmatic management of drug-resistant TB patients with the TB team (physician, nurse, pharmacist, lab. technician if needed).

1- What is the size of MDR-TB problem locally?
   a. Significant problem
   b. As expected
   c. Rare
   Describe if possible _____
2- How many cases of MDRTB were detected during the 2016 at the visited facility? Check records (_____)
1- How many patients with MDRTB are presently being treated at the facility? Check records (_____)
2- What is the procedure for managing a patient suspected of having drug-resistant TB?
   _____
   _____
   _____
3- Is there diagnostic capacity for detecting drug-resistant TB – for example, are diagnostics available (Sputum Xpert MTB/RIF test or Drug Susceptibility Testing)?
   a. Yes
   b. No **skip next question**
4- Are all previously treated patients during 2016 tested using DST (Drug Susceptibility Test)?
   a. Yes
   b. No

c. Not applicable

5- Are patients with MDRTB referred to other facilities designated by HAAD-DOT program?
   a. Yes
   b. No
   c. Not applicable (no patients with MDRTB detected for the last 2 years)

6- What proportion of specimens from new TB cases undergo DST? Check for TB cases seen in 2016
   a. All
   b. Majority (more than half of the cases)
   c. Few (not many but more than one)
   d. None

7- How are laboratory confirmed MDR-TB patients treated?
   a. Under DOT with strict follow up
   b. Under DOT with regular follow up
   c. Regular follow up visit without DOT
   d. Treatment is not available in this facility
   e. Others, mention _____

8- Are second-line anti-TB medicines available?
   a. Yes
   b. No **End of the section**

9- Which type of treatment is used for MDR-TB patients:
   a. Hospital-based
   b. Community-based? **End of the section**
   c. Not Applicable **End of the section**

10- If MDR-TB patients are treated in hospital,
   a. Is there capacity to provide respiratory isolation for patients who remain culture-positive while being treated? Observe and verify
      i. Yes
      ii. No

   b. Are TB infection-control measures in place for the isolation facilities? Observe and verify
      i. yes
      ii. No

Part (7) Assessing TB/HIV collaborative activities:

Location: TB units and HIV units, or points where service delivery is integrated, at the health-facility level or point-of-care level. Administrative offices deputed to plan and manage TB/HIV collaborative activities

Who should be interviewed: meet the focal points for both TB and HIV program at the HCF or the healthcare professionals responsible of delivering related services. Meet providers of health services at delivery points or the infection control staff.

A) Review TB/HIV policy and guidelines

1. Are the facility team aware about HAAD circular (DG/67/13) dated 12/Nov. 2013 regarding HIV testing for confirmed TB cases? Check documents,
    a. Yes
    b. No
2. Are all confirmed TB patients tested for HIV? Check samples from facility TB records or notifications.
    a. Yes
    b. No **Go to question 5**
    c. Partially
3. Where they are tested?
    a. At the same facility
    b. Referred to another facility where the test is available (mention the facility please) _____
4. How often they are tested: **MCQ**
    a. At the initiation of treatment
    b. Monthly throughout the treatment course
    c. At the end of the treatment course
    d. Others:_____
5. If the uptake of HIV testing is low, where are the bottlenecks or what are the challenges to scaling-up HIV testing for TB patients?
    a. Rejection from the patient
    b. Difficulty in obtaining the patient consent
    c. Unavailability of the test
    d. Others_____
6. Do you have HIV positive TB patient managed in this facility for the year 2016?
    a. Yes
    b. No **Go to question 9**
7. Do all HIV-positive patients with TB receive antiretroviral treatment (ART) regardless of their CD4 count?
    a. Yes
    b. No
8. Is early ART (Antiretroviral Therapy) given to HIV-positive TB patients within 8 weeks of starting TB treatment?
    a. Yes
    b. No
9. Are people living with HIV screened for TB each time they visit a health facility?
    a. Yes
    b. No
    c. Not applicable
10. Is isoniazid preventative therapy (IPT) offered to people living with HIV after active TB disease has been ruled out?
    a. Yes
    b. No
    c. Not applicable

B) Review TB/HIV collaborative mechanisms:

11. Is there a referral mechanism for HIV-positive TB patients who need care and support for HIV? Check records
    a. Yes

b. No
c. Not Applicable

12. Are there any arrangements in place to ensure that HIV care and treatment continue for HIV-positive patients after they complete treatment for TB?
    a. Yes, describe:_____
    b. No
    c. Not applicable

C) Review TB/HIV activities at facilities providing HIV services:

13. Are people living with HIV routinely screened for TB? Check records of people living with HIV?
    a. Yes,
    b. No **Go to question 17**
    c. Partially
    d. Not applicable **Go to question 17**
14. If yes, where they are screened?
    a. At the same facility
    b. Referred to another facility where the test is available (mention the facility please)
    _____

15. How often they are screened? (Review and describe the approach.) **MCQ**
    a. At the initiation of treatment
    b. quarterly throughout the treatment course
    c. once the patient develop suspicious signs and symptoms
    d. Others:_____
    b. Not done
    c. Rarely done
16. What is the screening algorithm? Answer with ordering sequence of algorithm
    a. _____
    b. _____
    c. _____
17. If TB screening was not done, was rarely done or was poorly done, what are the main reasons?
    a. Rejection from the patient
    b. Difficulty in obtaining the patient consent
    c. Unavailability of the tests
    d. Financial issues
    e. Others_____

18. What are the main concerns about diagnosing TB in patients who are HIV positive?
    _____
    _____
19. Are measures in place to control the spread of TB infection in facilities caring for HIV-positive patients or in facilities offering integrated TB services and HIV services? (observe and verify)
    a. Yes
    b. No
20. Are there any concerns about infection control in these facilities?
    a. Yes, mention please _____
    b. No

Part (8) Assessing patients' adherence to TB treatment:

Location: hospital ward, TB outpatient clinic (daily OPD or infectious disease clinic)
Who should be interviewed: If possible, interview a selection of inpatients and outpatients and review their treatment cards. Patients should be told that the interview is voluntary, that any information provided will remain confidential, and that permission will be asked before photographs are taken. **The recommended number of patients to be interviewed at each facility is two or three.**

1- How well do health workers communicate with patients? (Observe communication between health workers and patients, and the attitude of health workers towards patients.)
   a. Fine communication
   b. Acceptable
   c. Poor communication
   d. Others:_____
2- Do patients know that they are being treated for TB or for MDR-TB (if relevant)?
   a. Yes
   b. No
3- Do patients know how long their treatment for TB will last?
   a. Yes
   b. No
4- Do patients take their medication while they are being directly observed?
   a. Yes
   b. No
5- Is treatment convenient for the patient in terms of the time and location?
   a. Yes
   b. No
6- Do patients take their medication regularly?
   a. Yes
   b. No

7- How many doses were missed during the past month?

   _____
8- What are the main issues that affect whether a patient follows the treatment plan? for example, has the patient had any
   a. adverse effects,
   b. problems with deliveries of medicines or DOT services,
   c. transportation issues
   d. problems at work
   e. others:_____
9- Are the treatment cards correctly filled and used?
   a. Yes
   b. No
   c. Partially
10- Do patients in the continuation phase know about the schedule for follow-up sputum examinations and the final review?

a. yes
b. No
c. Partially

11- Do patients pay for their anti-TB medicines or other health-facility fees?
a. Yes, total payment
b. Partial payment
c. No payment

12- Do patients incur other costs directly related to their disease (for example, for tests and medicines, and for managing adverse reactions)?
a. Yes, total payment
b. Partial payment
c. No payment

13- Has the patient ever been treated for TB in the past:
a. Yes
b. No
c. Can't re-call

14- Do patients know how they became infected with TB?
a. Yes
b. No

15- Have patients received health information about their disease, treatment and prognosis?
a. Yes
b. No
c. Partially

16- Do they understand the information that they were given?
a. Yes
b. No
c. Partially

17- Do patients feel that the health-care services satisfactorily address the emotional and spiritual suffering that results from the disease and its treatment?
a. Yes
b. No
c. Partially

18- Do patients feel that their privacy is respected when they interact with the health services?
a. Yes
b. No
c. I don't know

19- Do patients receive any incentives or enablers to continue treatment (for example, food, transport vouchers or money)?
a. Yes
b. No

20- What do patients' families and people in their communities think about TB (interview companion of TB patients if possible)
a. Disease that can be cured
b. Disease troubling their life
c. Disaster
d. Stigma
e. Others:_____

21- Do patients feel stigmatized or discriminated against because of their disease?
a. Yes
b. No

Part (9) Assessing the management of anti-TB medicines and supplies:

Location: pharmacies at HCF or TB clinics

Staff to be interviewed: TB coordinators or TB focal points, pharmacists, staff at the medicine and supply unit.

1. Who is in charge of ordering and receiving anti-TB medicines and supplies?
   - Mention the job title and position (_____)
2. If the person is available, ask about the procedures used to verify and document the quantities received (regarding anti TB needs and supplies as part of the general items)

   _____
   _____
3. Does the facility use a register (or automated system) for medicines or supplies to track the delivery, receipt and movement of each item? Check and verify
   a. Yes
   b. No
4. Are expiry dates monitored? Check and verify
   a. Yes
   b. No
5. Where are orders for medicines and supplies fulfilled?
   a. from a regional store
   b. central store,
   c. directly from suppliers or wholesalers
   d. others, please describe from where _____
6. What procedures have been established to ensure that health facilities receive medicines and supplies regularly?

   _____
   _____
7. How often are supplies received?
   a. Monthly
   b. Quarterly
   c. On need
   d. Others, describe_____
8. Who determines what supplies are needed and places the order?
   a. Pharmacist in charge
   b. Infectious disease physician
   c. DOT focal point
   d. Others, mention please_____
9. Are first-line anti-TB medications available?
   a. Yes,
   b. No **skip next question**

10. Which of the first line ATT medicines are available?
    a. Rif.
    b. INH
    c. PRZ
    d. Ethambutol

e. Streptomycin
f. Others_____/_____/_____/_____

11. Are second-line medicines available?
    a. Yes
    b. No **skip next question**
12. Which of the second line ATT medicines are available?
    a. _____
    b. _____
    c. _____
    d. _____
13. Is there a buffer or safety stocks of anti-TB medicines?
    a. Yes,
    b. No **skip next question**
14. How long should the buffer stock last?
    a. 1-3 moths
    b. 4-6 months
    c. More than 6 months
15. What anti-TB medicines are available for children?
    _____/_____/_____/_____
16. Are pediatric formulations available?
    a. Yes **End of the section**
    b. No,
17. Are adult tablets broken in half for children?
    a. Yes
    b. No

Part (10) Assessing recording and reporting

Location: HCF dealing with TB cases detection, reporting, management and follow up.
Staff to be interviewed: Health care staff dealing with case reporting or infection control staff

1. Are the following recording and reporting (hard copy or electronic) forms available and used at the healthcare facility level? (circle the answer)
    a. Request form for sputum-smear microscopy examination; Yes No
    b. Request forms for culture and DST (if relevant); Yes No
    c. TB treatment card; Yes No
    d. TB treatment referral or transfer-in form; Yes No
    e. Register of patients suspected of having TB; Yes No
    f. Register of TB contacts Yes No
2. Is electronic system for reporting in place?
    a. No, completely paper-based
    b. Yes, for all TB patients (suspected and confirmed PTB and Extra PTB)
    c. Yes, only for certain TB patients (specify)_____
3. To which extent the electronic reporting system can be used for TB reporting?
    a. Easy
    b. Moderate
    c. Difficult
4. Do you have a valid account on electronic -Infectious disease reporting system of HAAD?

a. Yes check at least the account of the staff interviewed
b. No

5. Are you aware with the stages in the TB notification sub form on HAAD electronic system?
   a. Yes
   b. No **Go to question 8**
6. How many stages are in the TB sub form on the electronic system:
   a. 1 stage
   b. 2 stages
   c. 4 stages
   d. 6 stages
   e. More than 6 stages

7. Are stages in the TB notifications sub forms are filled in due time? Check 2-3 notifications submitted by the facility from the year 2016
   a. 2nd stage only
   b. 2nd and 3rd stage only
   c. 2nd -4th stage
   d. 2nd -5th stage
8. Is regular reports for TB cases enrolled in DOT are submitted by the TB focal point or infection control staff to CDD/HAAD regional office?
   a. Yes, **Go to next question**
   b. No **End of interview**
9. If yes, is that on regular basis?
   a. Yes
   b. No
10. If yes, at what day of the month the report for the previous month is submitted? Check sample of the report (excel sheet) and obtain copy of the report
    Day number _____
11. Are the data for TB cases in the regular report are updated on monthly bases with the patients follow up data? Check at least last report submitted by the facility and compare it with the patient's file
    a. Yes
    b. No

Part (10) Assessing infection control

Location: outpatient clinic at a health facility, hospital ward, HIV-care clinics, any health facilities that see TB patients or patients suspected of having TB,

Staff to be interviewed: health-care staff, infection control (IC) chair, IC staff or IC link.

1. Is infection control plan in place? Observe and verify
    a. Yes
    b. No
    c. partially
2. Is focal person for TB infection control identified?
    a. Yes
    b. No
3. Are health workers been trained in infection–control procedures?
    a. Yes
    b. No
4. Are health workers practicing infection–control procedures? Observe and verify
    a. Yes
    b. No
    c. partially
5. Is there any separation of infectious patients (including suspected or confirmed TB patients) from non-infectious patients in the waiting area? Check and verify
    a. Yes
    b. No
6. Is cough hygiene policy established for education of patients? Check for evidence
    a. Yes
    b. No
7. Is surveillance for TB among health-care workers established?
    a. Yes
    b. No **skip next question**
8. If yes, how often:
    a. One time
    b. Yearly
    c. Others_____

9. Are TB Patients provided with educational materials about TB? check and verify
    a. Yes
    b. No

10. Are health workers educated about the signs and symptoms of TB, and TB infection-control procedures? Ask and verify
    a. Yes
    b. No
11. Are appropriate Ventilation systems available in high risk area (ER, Lab, infectious disease clinic, Isolation ward)?
    a. Yes
    b. No **skip next question**
    c. Partially
12. Are ventilation systems functioning well?
    a. Yes
    b. No
    c. Partially
13. Are hepa filters available? Check and verify
    a. Yes
    b. No

14. Are surgical masks available for suspected or confirmed TB patients? Check and verify
    a. Yes
    b. No

Part (11) Assessing public–public and public–private mix approaches:
This part should be filled whether the facility is public or private

Location: TB clinics or outpatient clinic in private health care facilities and public- healthcare facilities
Staff to be interviewed: health care professionals at private and public healthcare providers

1. Are operational guidelines on public–private mix approaches (coordinating procedures for TB patient referrals and follow up) available from the HAAD-DOT program?
    a. Yes
    b. No **skip next question**
    c. Not applicable **skip next question**
2. If yes, are they used?
    a. Yes
    b. No
    c. I don't know
3. Have sensitization and training activities been conducted for public-private coordination in detection and management of TB patients?
    a. Yes, when _____
    b. No
    c. Not applicable
4. How do they collaborate with the HAAD-DOT program or the reference lab for sputum culture?
    _____
    _____
5. Is this facility private?
    a. Yes
    b. No **End of interview**
6. If yes, do facility laboratories have the resources for diagnosing smear-positive TB patients?
    a. Yes
    b. No
7. Do facility laboratories have the resources for diagnosing patients with MDR-TB?
    a. Yes
    b. No

8. Do private practitioners treat patients with confirmed TB disease?
    a. Yes
    b. No
9. Are anti-TB medicines, including first or second-line medicines, available in private pharmacies?
    a. Yes
    b. No
    c. I don't know
10. Is the HAAD Standards for TB Care known (DOT) check and verify
    a. Yes
    b. No

APPENDIX 2

TB Evaluation Framework for TB unit

Name of facility:
Date of the visit: / / 2017
Time: from To

Visiting team:

	Name	Place of work	Mobile No.	signature
1				
2				
3				
4				

Staff from the facility interviewed:

	Name	Place of work	Mobile No.	signature
1				

Report submitted to CDD/HAAD on / /2017

Received by: Name & signature

Assessing the management of the TB control program at HAAD level

Section (A):TB control Strategy

1. Is the strategy to prevent and control TB included in the strategic health plan at HAAD level?
    a. Yes
    b. No
    c. NA
2. Is there a strategic plan for TB control at HAAD level?
    a. Yes
    b. No
3. If yes, is the plan consistent with the national strategic plan?
    a. Yes
    b. No
4. Is the document detailing the national policy to prevent and control TB available at the coordination unit (DOT team at CDD/HAAD)?
    a. Yes
    b. No
5. Are the guidelines produced by the central unit (at MOH level) of the national TB program available at the coordination unit?
    a. Yes
    b. No
6. Is there a standard for the diagnosis, reporting and case-management of patients with TB produced by CDD/HAAD?
    a. Yes
    b. No
7. Is this standard applied?
    a. DOT strategy
    b. Other strategy, _____
8. Is the standard for establishing the diagnosis of TB aligned with international standards?
    a. Yes
    b. No
9. Do this standard specify the diagnostic process to be used to identify different types of TB?
    a. Smear-positive pulmonary TB yes No
    b. smear-negative pulmonary TB Yes No
    c. Extra-pulmonary TB Yes
       No
    d. childhood TB Yes No

Section (B): TB/HIV collaborative activities:

10. Is there a national policy and are there national guidelines on TB/HIV collaborative activities?
    a. Yes
    b. No, why _____ skip next question
       _____

_____

11. If yes, when were both the TB/HIV policy and the guidelines last updated?

_____

12. Are both the national policy and the guidelines aligned with international recommendations?
    a. Yes
    b. No

Section (C): TB in Childhood

13. Is childhood TB included in the HAAD standard to prevent and control TB?
    a. Yes
    b. No
14. Are there any training materials about implementing activities to address childhood TB?
    a. Yes
    b. No
15. Have specific staff within the central unit been assigned to coordinate activities for childhood TB?
    a. Yes
    b. No

Section (D): Funding

16. Are any TB activities funded from the local budget?
    a. Yes
    b. No
    c. Others_____
17. Have any local sources of funding been mobilized for TB activities?
    a. Yes
    b. No
18. How reliable are these sources of funding? Describe:

_____
_____

Section (E): Training

19. Does the coordination unit implement training for health workers at intermediate-level facilities?
    a. Yes
    b. No
20. If yes,
    a. Are the national training materials produced by the central unit available?
        i. Yes
        ii. No
        iii. Others describe:_____
    b. Who are the trainers?

_____
_____
_____
_____

    c. Is there a current training schedule?
        i. Yes
        ii. No

d. How many training sessions were planned during the previous period (2016)?
_____
_____
_____
_____

e. How many of the planned training sessions were actually organized?
_____
_____

f. Are there any reports from these sessions?
   i. Yes
   ii. No

g. Does the coordination unit use the training programs developed by the central unit of the national TB program?
   i. Yes
   ii. No
   iii. Others, mention please
   _____
   _____
   _____

Section (F): Supervision

21. Does the coordination unit organize supervisory visits to health care facilities?
    a. Yes
    b. No
22. If yes,
    a. Is the national guideline describing how to conduct a supervisory visit available?
       i. Yes
       ii. No
    b. Which staff members supervise TB care and control activities at the health facilities?
    _____
    _____
    c. Have these staff members been trained to undertake supervisory visits?
       i. Yes
       ii. No
    d. Has a schedule been established to ensure that staff at the coordination unit undertake supervisory visits?
       i. Yes
       ii. No
    e. For which time period has this schedule been established?
       i. for a quarter,
       ii. fora semester or
       iii. for a year
       iv. others _____
    f. How are health facilities selected for inclusion in the supervisory schedule?
    _____
    _____

_____
_____

g. How many supervisory visits were carried out and how many were planned during the period covered by the previous schedule (year 2016)?

_____

h. Are reports from supervisory visits available for the period covered by the previous schedule?
   i. Yes
   ii. No **Go to question (l)**

i. If yes, were the strengths and weaknesses of the care and control services clearly identified?
   i. Yes
   ii. No

j. Were the recommendations clearly identified?
   i. Yes
   ii. No

k. Are the recommendations consistent with the identified strengths and weaknesses of the facilities?
   i. Yes
   ii. No

l. How often was the coordination unit visited by staff from the national TB program's central unit during the past 12 months?

_____

m. Are reports of the supervisory visits conducted by staff from the central unit available at the coordination unit?
   i. Yes
   ii. No skip next question

n. If yes, are these reports the same as those at the central unit?
   i. Yes
   ii. No

23. Are meetings organized regularly by the coordination unit with health-care workers providing TB care and control services?
    a. Yes
    b. No **Go to question (27)**

24. If yes, how many meetings are organized each year?

_____
_____
_____
_____

25. What issues are raised and discussed in these meetings?

_____
_____
_____

26. Are notes taken at each meeting?
    a. Yes
    b. No

(The reviewer should check notes from the meetings and record the issues that were raised.)

27. Are there any mechanisms in place to ensure that services are coordinated with partners that are locally involved in TB efforts?
    a. Yes
    b. No **Go to section (G)**
28. If yes, who are these partners?
    a. b. c. d.

29. How are services coordinated with other care providers, particularly those who are practicing in hospitals, or in health units in prisons, or in the private and semiprivate sectors?
    _____
    _____
    _____
    _____

Section (G): Recording and reporting:

30. What is the type of system used for recording and reporting TB cases at the HCFs level?
    a. Paper based
    b. Electronic
    c. Others _____
31. Is Electronic system at HAAD level in place?
    a. Yes, for all TB patients
    b. Yes, only for certain TB patients (specify) _____
    c. No, completely paper-based **Go to question 34**
32. How far is the coverage of the electronic system?
    a. Complete Abu Dhabi emirate coverage
    b. Partial geographical coverage
    c. Excludes certain facilities (for example, prisons, military facilities, general hospitals, private clinics)
    d. Excludes private sector (give more details: _____)
33. If an electronic system is in place, specify the type:
    a. Web-based (via Internet browser)
    b. Installed software, open-source
    c. Installed software, not open source
    d. Installed software, other
    e. System based on paper or transfer of worksheets (for example, Excel pages)
34. Does the dataset in the reporting system include minimal information about?
    a. notification by age and sex, Yes No
    b. address and contact details Yes No
    c. type of TB, (by site of the disease) Yes No
    d. patient's clinical symptoms Yes No
    e. diagnosis category Yes No
    f. information on sputum conversion Yes No
    g. treatment category Yes No
    h. TB determinants Yes No
    i. Lab. results, including results from sputum smear and culture, Yes No
    j. Xpert MTB/RIF test Yes No
    k. DST Yes No
    l. HIV test Yes No

m. Treatment monitoring and follow up, Yes No
n. treatment outcomes Yes No

35. Are all data from TB activities carried out at the intermediate level (HCFs level) available at the coordination unit (DOT team /CDD/HAAD)?
    a. Yes
    b. No **Go to section (H)**
36. If yes,
    a. Through which channels are data received from the peripheral DOT clinics and other health facilities?
        i. Excel sheet by email
        ii. Mail
        iii. Fax
        iv. Others _____

    b. Are these data sent over the Internet or through other administrative channels regularly and in a timely manner?
        i. Yes
        ii. No

    c. What is the kind of system used for compiling data?
        i. paper-based
        ii. computer-based

    d. Are the data
        i. aggregated
        ii. case-based
        iii. both
    e. Is the dataset model used in the coordination unit (DOT team at CDD/HAAD) similar to that used in the national program's central unit?
        i. Yes
        ii. No
    f. Are data on TB and TB prevention, care and control collected and compiled in other information systems that are not connected to the national program?
        i. Yes, describe _____
        ii. No
    g. Are data analyzed regularly (MCQ)?
        i. Yes
        ii. No **Go to section (H)**

    h. If yes, how often?
        i. monthly
        ii. quarterly
        iii. biannually
        iv. annually

    i. What types of data analysis are carried out, and what types of results are generated by these analyses?

_____
_____
_____
_____

j. Are these reports communicated to the entities that need to be informed (for example, to health-care staff, partners, and primary health-care services)?
   i. Yes
   ii. No **skip next question**

k. How are they communicated?

_____
_____
_____

l. Are these reports and data discussed at meetings regularly organized by the coordination unit (DOT team at CDD/HAAD)?
   i. Yes
   ii. No

_____
_____

Section (H): Contact Management

37. Is the TB control team at CDD/HAAD involved in contact tracing?
    a. Yes
    b. No
38. If yes What are they involved in the following contact tracing activities:

a.	Putting the schedule for contact screening	Yes	No
b.	Identify the case where contact screening is indicated	Yes	No
c.	Identifying the exposed contacts	Yes	No
d.	Referring the contact for screening	Yes	No
e.	Screening the exposed contacts	Yes	No
f.	Receiving the results	Yes	No
g.	Follow up of LTBI treatment	Yes	No

39. Is there any staff within the TB control team at CDD/HAAD assigned for contact tracing?
    a. Yes
    b. No
40. How the TB control team at CDD/HAAD identifies the exposed contacts?
    a. By interviewing the patient or family member
    b. By calling the patient
    c. By calling the sponsor or family member

Section (I): Human resources:

41. What are the human resources requirements for different tasks associated with the TB program? (Conduct a task analysis)

_____
_____
_____
_____(for more information can use the back of this page)

42. What are the implications for the workforce?

_____
_____
_____
_____

_____
_____

43. What is the current human resources situation at the national TB program?

_____
_____
_____

44. Are there enough staff?
    a. Yes
    b. No
45. Are staff well trained?
    a. Yes
    b. No
    c. partially
46. Are there any human resources gaps in terms of the number of staff required – that is, will more staff be needed as the program expands and staff take on additional roles and responsibilities?
    a. Yes
    b. No
47. Are there any gaps in the quality of staff that is, do the knowledge and skills of staff need to be improved?

_____
_____
_____
_____
_____

48. Are there enough appropriately skilled staff to implement the proposed work-plan?
    a. Yes
    b. No
    c. Partially
49. What types of solutions and activities would be sustainable in terms of addressing any gaps?

_____
_____
_____
_____

End of the interview

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Chapter 5

Recommendations for TB Control Program and Policy Improvement

The previous chapters provided rich information about the tuberculosis control program in Abu Dhabi. A detailed epidemiology is provided to understand change over time and the most affected subgroups of the community, followed by a discussion of TB diagnosis and the adoption of a new rapid PCR test in screening programs for expatriates, and ending with a qualitative review and evaluation of the program in its various stages in the Emirate.

This section is intended to provide some feedback and recommendations to improve the effectiveness of the program in future.

It is clear from the review that tremendous efforts and resources were put into the TB screening and early detection program. This was clear in national and local policies that clearly identified requirements for detailed screening and reporting. One of the strengths identified in the program in Abu Dhabi is the electronic reporting system that captures data and provides policymakers with the information needed for decision-making purposes. However, additional effort is required in the next years to strengthen procedures for the treatment of TB DOTs and to improve access for high-risk groups. The following are details of opportunities to strengthen the performance of the program to align more with the WHO End TB Strategy.

Planning and TB Policy

The evaluation provided some feedback about the current performance of the central program unit and identified some areas for improvement. The program requires additional work to strengthen preventative measures for children by providing clear guidelines and training healthcare staff on the screening, prevention and management of TB in children. The link between the TB/HIV program can be further strengthened by having collaborative activities and joint guidelines. The lack of budget for TB awareness clearly affects the overall performance of the program. Collaboration with other health, non-profit or private organizations to work with DOH and participate in awareness activities is needed. A revision of human resources is required in terms of staff numbers needed to ensure an adequate workforce to cover the daily functions of contact tracing, field visits, training, and awareness activities. It is clear from the review that the program has good KPI measures that cover process and outcomes. This, however, can be further improved by setting targets by 2020 in comparison to 2015 for decreases by 20% in burden of TB, and 35% in mortality associated with TB. This study provides baseline data for the year 2015 that can be adopted and monitored in the future.

Case Detection

Early detection of cases is a very important element of the TB control strategy and the review confirms that this is one area of the strength in Abu Dhabi. The visa screening services have good elements of screening and cover adult expatriates that comprise the majority of the population. Access by the private sector for confirmation of suspected cases by referral of samples to the central lab is good practice in identifying potential cases. Some practices in primary health care

settings, such as areas of sputum collection, need to be addressed and improved upon as well as stressing the importance in educating health care professionals to develop best practice in the suspicion of TB.

Diagnosis and Confirmation

The first pillar of the WHO Stop TB strategy is to have integrated, patient-centered TB care and prevention. In reviewing the system in Abu Dhabi, it is clear that the system has strengths in areas of TB care such as the introduction of TB DOT in primary health care settings for better access and follow-up for adult patients. However, it is unclear which facility is in charge of patients with MDR or XDR and this is a very important component of TB management. Care needs to be taken of difficult cases of TB who failed to respond in the first round or patients with MDR or XDR by facilities that have the infrastructure and resources needed for the management of those cases. They should be clearly identified as reference centers for the management of such patients.

Testing for second line sensitivity for TB medication is not available in the health care system in Abu Dhabi. This is a gap that needs to be closed. This can be done by selecting one lab to be the reference lab for TB sensitivity testing. This one lab can cover the needs of the whole emirate. This will help healthcare professionals to get specific information needed for a better management plan of patients with MDR or XDR. This will also limit the transmission of XDR in the community.

WHO recommends that programs have population representative data for drug resistance surveillance (DRS) that includes new patients, different categories of retreatment patients and high-risk groups.

Preventative Treatment for Latent TB

It is clear that the national and local programs focus on the treatment of close contacts exposed to TB patients and provide them with the proper preventative treatment required. However, the program does not elaborate on actions required for patients identified with latent TB. It is estimated that around 80% of incident cases are due to reactivated latent TB (11). Studies have found that the management of latent TB is a core intervention for TB control (7, 8, 9, 11).

The introduction of a community-wide preventative treatment for latent TB cases is a big step for the health care system in Abu Dhabi that needs to be studied, but it is also a game changing step that can reduce the burden of TB priority, especially among expatriates. Based on the available data, around 500-1,000 people might require referral from visa screening centers to a TB DOT facility for preventative treatment and follow-up. There are options for treatment regimens that can be used: the most effective one is weekly, directly-observed rifapentine plus INH (for three months). The estimated annual cost of this option will be around 4 million Dirhams for around 1,000 patients. It is important to engage different stakeholders in the discussion of how this service can be provided and what is to be the expected outcome.

Management and follow-up

The national and local guidelines follow international standards of care and management of patients with TB. The tracking of patient compliance to treatment is an important component of the TB control strategy. The evaluation provided some reasons why patient discontinue treatment.

This can be further studied and improved by improving access and patient education about the disease.

A delay in patient management by more than 90 days is associated with more transmission among close contacts, up to 40%, according to some studies (10). Therefore, it is important to ensure that confirmed cases get proper admission and management on time. It is important to focus on providing good access for TB DOT management for high risk groups such as labor camps by designating a clinic that provides TB DOT treatment. Public services provide exclusive treatment and there might be access issues for high-risk patients due to the location of those services. A suggestion of expanding the treatment to designated facilities in the private sector to improve access can be discussed with stakeholders.

The adoption of modern technologies to improve adherence of patients to treatment is one of the effective ways to improve patient compliance. Studies have proven the effectiveness of use of mobile video recording applications to enhance TB DOT (19). This option can be discussed based on budget availability for the enhancement of the control program.

Tuberculosis in Children

Prevention

Measures to prevent TB in children include screening of children who have been exposed to TB patients and providing them with necessary TB preventative medication. It is clear that contact tracing in children is currently separated from adult services and is only provided by tertiary care hospitals. Care providers must increase access for preventative services for children.

Management of Cases

Guidelines for the diagnosis and management of TB are currently unavailable but could be developed as an attachment to the national guidelines. In addition, a careful revision and definition of services that provide TB treatment for children must be carried out to ensure that cases with MDR or XDR are referred to a tertiary care facility for proper management.

TB Awareness and Collaboration

In order to change and upgrade the TB control program successfully, it is important to engage various stakeholders and discuss with them the options of how to make change happen and to persuade them to adopt one common plan. It is important to have a Public/Private partnership plan and to obtain the support of the private sector to ensure success.

Table 1, below, shows the main areas of change required and stakeholder mapping.

Table1: Summary of Action plan and stakeholders required

Objective	Key Action	Stakeholder	Action time-line
Improve preventative and curative treatment in Children	Revise TB guidelines and cover TB care for children	DOH, MOH	Short term
	Identify primary health care centers that can provide preventative & follow up for TB care for children	DOH, SEHA	Intermediate

Improve TB awareness	Create a program for TB awareness in collaboration with stakeholders	DOH, All stakeholders	Short term
Revise TB program KPIs	Set targets for TB reduction based on WHO End TB Strategy 2015	DOH, MOH	Short term
Improve access to treatment among high risk groups	Mapping of cases of TB for the last three years in comparison to DOT clinics	DOH	Short term
	Use of mobile application to track patient compliance to treatment	DOH, SEHA	Intermediate
	Introduce TB management in designated private facilities	DOH, Private sector	Intermediate
Drug Resistance Surveillance	Define a reference lab for MDR/XDR sensitivity testing	DOH, SEHA	Intermediate
Encourage TB Research	Define priority research areas and request funding	DOH, MOH, UAEU	Long Term
International collaboration for TB control	Establish link with TB control program in India and Pakistan. Provide some supportive funds	DOH, MOH, MOPA, MOFA	Long Term

International Collaboration

To strengthen the local control of TB, it is suggested that communication be strengthened with TB Control Programs in countries such as India and Pakistan who are responsible for most TB cases arriving in the UAE. This will have a positive effect on the incoming workforce to the UAE. This well-known practice is already implemented in the USA, for example, at the Mexican border to control imported cases of TB. Such robust collaboration between countries can help control the incidence of TB.

TB Research in UAE

Research is a very important component of the End TB Strategy defined by the WHO (1,2). Varying types of research are required globally to support elimination plans such as innovation on diagnosis, technology and prevention. The focus on the local needs in this study identified a few priority areas of importance to Abu Dhabi and include the following:

1- Program-based operational research to follow program effectiveness and provide accurate feedback on areas of improvement.
2- Genetic sequencing to understand more about the epidemiology of TB in Abu Dhabi, UAE. This type of research is well known and widely utilized for contact tracing and identification of sources of infection in the community.
3- Cost-effectiveness analysis to support guiding decisions toward most effective interventions.

A collaboration among local authorities and academic institutions is suggested to carry out research in appropriate areas.

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BIOGRAPHICAL STATEMENT

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Professional Profile	Public Health Professional with 14 years' experience and active work in this field. Started the profession working in the infectious diseases clinic and progressed in career until presently employed as Manager of the Communicable Diseases Department at HAAD. Studied as part time for MPH in John Hopkins Bloomberg of Public Health and currently in the final stages of my DrPH. Have special interest in knowledge transfer and teaching in UAEU as adjunct associate Professor in the Institute of Public Health. Founder and chair member of the Editorial Board for the Communicable Diseases Bulletin in Abu Dhabi as well as Chair of the Visa Screening Panel, HAAD, Abu Dhabi. Worked in the National level as member of national committees for strategic planning of outbreaks and pandemics and establishments of the national laws such as the National HIV law in 2010 and other regulations related to TB , Visa Screening and Infectious Diseases laws in 2016. Board Member of Rahma Association for support Cancer patients.
Education	• Adjunct Currently Part time student, DrPH in John Hopkins Bloomberg School of Public Health, USA • Public Sector innovation diploma, Cambridge university, UK, 2017 • MPH, John Hopkins Bloomberg School of Public Health, USA, 2011 • MBBS, FMHS, UAE University, UAE, 2003 • Silaa Secondary School, 1996
Professional Experience	**Manager of Communicable Diseases Department** *July 2012 - Present* Public Health & Research, Health Authority Abu Dhabi, Board • Active Participation in the strategy of public health and communicable diseases • Developing awareness programs for infectious diseases and vaccination to educate the public • update of vaccination program in Abu Dhabi Emirate and adding new vaccines • participation in review and update of infectious diseases regulations in UAE including Infectious diseases law 2014 and visa screening ministerial decree 2016 • introducing rapid response for infectious diseases

- Introducing TB DOT program in the Emirate of Abu Dhabi and later this was adopted for the whole UAE
- Acting Director of Public Health in addition to my job description from Sep 2014 until July 2015
- Leading the international collaboration of HAAD with CDC USA
- Leading Research related to MERS-CoV in UAE in collaboration with CDC USA
- Leading BSL3 reference laboratory for infectious diseases which is the only lab in UAE with this level for human health
- Setting the Strategic plan for the Department and designing the plans for the implementations according to the goals and objectives of the Communicable Diseases Department
- Evidence based decision making for the development and evaluations of the existing gaps in the health care system related to the control of infectious diseases in Abu Dhabi
- Leading the operational perspectives of Communicable diseases surveillance and monitoring including: E-Notifications, Premarital Screening, Malaria Control, Vaccinations and outbreak response and management
- Active members in several Committees in Abu Dhabi including the Disciplinary Committee, Emergency preparedness and response, Tender Committee, and Visa Screening Panel.
- Member of National Committees for the design and regulations of few national programs such as HIV national Committee, and Visa Screening National Committee

Section Head, Communicable Diseases *2010-2012*

Public Health & Policies, Health Authority Abu Dhabi

- Supervise the functions of infectious diseases section including: Visa Screening, Infectious diseases Notification, Vaccination programs in the Emirate of Abu Dhabi, HIV, Malaria Control, Tuberculosis control
- Review and analysis of Communicable diseases trends and plan for control measures according to the priority of diseases.
- Evaluation and assessment of infectious diseases surveillance systems.
- Participated in the review and establishments of several laws in UAE such as the Visa Screening Laws 2010, HIV law 2010 and Public health law
- Part time student in MPH- DrPh in Bloomberg School Of Public Health
- Member of the Disciplinary Committee in HAAD which review cases related to the medical practice and decide on the actions and penalties for medical errors.
- Member of HAAD Emergency Command Center in charge of planning for disaster response and coordination with other involved agencies during crisis.

Senior officer, Communicable Diseases *2008-2010*

Public Health & Policies, Health Authority Abu Dhabi

- The lead of Visa screening program in Abu Dhabi
- Participated in the development of Visa screening standards for the Emirate of Abu Dhabi
- Design and implementation of Visa Screening electronic system
- Development of the electronic logic matrix for decision of fitness without human interference.
- Set out HIV response plan in Abu Dhabi in coordination with UNDP
- Lead the infectious Diseases Surveillance system and prepare the regular reports for analysis.

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Head, Infectious Diseases Control Section *2010-2012*

Preventive Medicine, General Authority of Health Services

- Handling suspected and confirmed infectious diseases cases from visa screening
- Coordination and communication with MOH and MOI in relation to positive HIV and TB cases
- Supervise the treatment and follow up of Contacts of infectious diseases
- Epidemiological investigation of certain infectious diseases of interest for possible outbreak
- Prepare the regular reports about infectious diseases status in the center
- Counseling of HIV cases notified and arrange for the referral and management
- Conducting the screening and counseling for Premarital screening program.

Teaching Experience

Adjunct Assistant Professor in the College of Medicine and Health Sciences, UAE University, October,2013 2011-2014

- Assisted in teaching of Epidemiology for Managers Course for Students in Masters of Health Administration, Zayed University in 2011, 2012 and 2013
- Assisted in teaching of Senior Clerkship Students specific session about Epidemiology of Infectious Diseases in Abu Dhabi, in February and May,2013, FMHS, UAEU
- Excellence in Teaching from UAEU 2014

Adjunct Associate Professor in the College of Medicine and Health Sciences, UAE University, October,2014

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- Excellence in Teaching from UAEU 2017

Research & Publications

- Leading the MERS-CoV research in UAE and the collaboration with CDC and other international entities
- Member of WHO research working group published:
  state of Knowledge and data Gaps of Middle East: Respiratory Syndrome Coronavirus (MERS-CoV) in Humans, November 2013
- Founder and chair member of the Editorial board for the Communicable Diseases Bulletin in Abu Dhabi which is issued quarterly in the following website:
  http://www.haad.ae/haad/tabid/1177/Default.aspx

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- Participated in the Conferences and Symposiums in the field of experience such as:

- Outbreak Response and Management Course 2013
- Speaker in different conferences during 2012 such as:
- Vaccine Congress October, 2012
- 2nd GCC Pediatric Summit Sep,2012
- Leaders in Health Care, Dubai June 2012
- Premarital Screening workshop (February,2011)
- Visa screening Training workshop 2010
- Series of workshops about Tb management 2010
- Speaker in the food safety conference April,2010

Membership in Professional Societies	Member of female Medical student association, FMHS, UAEU, 1999-2000 Member of Emirates Medical Association 2007 Member of American Public Health Association 2013 Member of FMHS Alumni John Hopkins Bloomberg School of Public Health Alumni 2003 Member of HIV National Committee, Ministry of Health 2009 Member of H1N1 National Technical Committee, MOH, UAE 2008

	Member of Visa Screening National Committee, MOH 2007 Member of Home Screening National Committee, MOH 2011 Member of HAAD Disciplinary Committee, Health Authority Abu Dhabi. Chairing Visa Screening Panel, HAAD, Abu Dhabi Member of Advisory National Technical Committee for biosecurity, 2014 until now Board member in Rahma Association 2015 until now Member of Disciplinary Committee, HAAD from 2009 until now Member of Tender Committee HAAD 2012 until now
Training and Media Participation	• Participated in the planning and implementing of multiple training programs such as: • Outbreak Response and Management with MOH Oman in Abu Dhabi 2012 • Influenza Surveillance Workshop in Abu Dhabi 2013 • Outbreak Response and Management Workshop with EMPHINET in Abu Dhabi 2013 • MERS-CoV training Workshop in 2013 • Series of Training workshops for Vaccination 2012-2013 • 2005/2006 Organizer of the Notification of Communicable diseases Campaign– GAHS - A.D. UAE • 2006 Attended the 1st Annual International infectious disease congress – Harvard Medical school Dubai center – Dubai – UAE • 2006 Completed MIMMS (major incident Medical management and support) • July 2006 Leadership Training Program (Leadership skills, Supervising team work, Performance Management, Training skills and motivating employees) • 2007 HIV workshop organized by UNDP and the ministry of health, Abu Dhabi, UAE • 2007 Premarital testing workshop, Dubai, UAE • 2007 Implementation of breast screening program workshop ,Abu Dhabi-UAE • 2008 Dhaman first annual conference – Healthcare Management ,Abu Dhabi-UAE • 2008-2009 organizer of series of workshops for changing community response towards HIV: • HIV workshop for media (Nov.,2008) • HIV workshop for Healthcare workers (Dec.,2008) • HIV workshop for Religious leaders (Jan.,2009)

	• H1N1 Training: series of workshops for health care workers (June-Nov,2009) • H1N1 Training: series of workshops for school professionals (August-October,2009) • 2010-2011 organizer of series of training workshops • Series of workshops about Notification system in HAAD (Dec.,2010) • July 2006 Leadership Training Program (Leadership skills, Supervising team work, Performance Management, Training skills and motivating employees) • Participated in Khatwa show in Abu Dhabi TV in Dec 2011 for HIV awareness • Participated in TEDx Al Ain event for Young leaders in 2011 • Participated in design of the communication plan and the spokesperson in Press conferences and media representation in several events such as: • Press Conference for Launch of Vaccination Campaign May 2012 • Press Conference of Adult Vaccination Schedule July 2012 • Press Conference for Haj & Omra Campaign August,2012 • Press Conference for School Health	
Awards	• Best National Academic Performance Award, 1997 • Mumtaz- Bravo Award, 2009 (by Health Authority Abu Dhabi) • Short listed for the Abu Dhabi Award for Excellence in Government Performance/ Category Three/Manager Supervisory Award, 2013 • Excellence in Teaching Award, UAEU, 2014 • Excellence in Teaching Award, UAEU, 2017	
International Collaborations	• The lead person of Collaboration between HAAD and CDC for MERS-CoV • A member of International Health Regulations network and assigned as Abu Dhabi Focal Point • A lead person in the Negotiation and MOU between HAAD and EMPHINET. • Attended the IHR training workshop in Jordan, Amman • A member of the National Delegates for the Inter-country MERS-CoV meeting in Cairo, June 2013 • Active in the Collaboration of HAAD with MOH Oman, arranged the Influenza Surveillance workshop in Abu Dhabi in collaboration with MOH Oman • Active in the Collaboration of HAAD with MOH Oman, arranged the Outbreak Management workshop in Abu Dhabi in collaboration with MOH Oman • Active Member in the Collaboration with CDC, USA. Invited them for evaluation of the Infectious Diseases e-Notification system • A member of the National Delegates for the WHO Sixty-Third World health Assembly, Geneva 16-22May. • Supervising the collaboration with UNDP for the HIV response plan	2013-2017 2011-2013 2013 2013